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*Symposium on*
*Implications of Electronic Data Processing*
*for*
*Tax Administration and Tax Policy*



PUBLISHED QUARTERLY BY THE NATIONAL TAX ASSOCIATION

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## EDITOR'S NOTE

In April of this year a conference was held at Harvard University on the "Implications of Electronic Data Processing for Tax Administration and Tax Policy." The subject, we knew, would be particularly interesting to readers of the *Journal*, and therefore arrangements were made in advance of the meeting to publish conference papers and discussion notes as a symposium in this issue. To our knowledge, this is the first public discussion of the many issues which EDP has raised for tax administrators, lawyers, auditors, and economists alike in the tax field.

The conference was organized by Harvard Law School Professors Oliver Oldman and Stanley Surrey (now Assistant Secretary of the Treasury) and was sponsored jointly by the Littauer School of Public Administration and the Law School's International Program in Taxation. Thirty-seven people with varied professional backgrounds were invited to participate in the conference, and their comments on particular papers have been summarized in notes appended to the papers concerned. We are grateful to Roy E. Baker and John F. Cannon for the preparation of these notes.

One paper which was presented at the conference, "Beyond Document Retrieval toward Information Retrieval: Federal Estate Tax," by Professor Layman E. Allen of the Yale Law School faculty has not been included in this symposium because of space and printing problems. The paper describes a method of organizing written tax materials, applies the method to sample sections of the Internal Revenue Code dealing with the gross estate provisions of the Federal Estate Tax, and finally discusses some of the kinds of operations that electronic and mechanical devices will be able to perform with respect to materials organized in the suggested form. Subscribers of the *Journal* may obtain copies of this paper, until the supply is exhausted, by addressing requests to Professor Oliver Oldman, Harvard Law School.

All other conference papers are included in this issue, as well as one additional article, "Simulation and Tax Analysis: A Research Proposal" by Wilbur A. Steger of the RAND Corporation, which was obtained independently of the conference.

Finally, we wish to express our appreciation to the conference's main speakers. It is one thing to prepare material for an informal talk but quite another to prepare the same material for publication as a journal article. Each paper is informative and thought provoking and we are pleased to be able to publish them in this form.

LAWRENCE E. THOMPSON

# ELECTRONIC DATA PROCESSING IN THE INTERNAL REVENUE SERVICE

WILLIAM H. SMITH *

*Introduction*

ELECTRONIC data processing or EDP will have a marked effect on federal tax administration. It constitutes a benchmark in the history of paperwork processing for taxation purposes as significant—or perhaps even more significant—as the change which signalled the substitution of machine for manual methods with the introduction of card punch and electric accounting machine equipment. However, since EDP appeared on the tax horizon, tax administrators have been confronted with a variety of situations calling for decisions which previously never had to be faced, simply because systems capabilities and capacities were frequently insufficient to make it necessary to weigh alternatives. The limitations imposed by the resources structured the processing framework to an extent that in many areas few practical choices were available. This is no longer true and one of the more important of the complex of operations involved deals with the recording, storage and matching of tax data, which this paper, in part, will treat from the viewpoint of the Internal Revenue Service of the United States Treasury Department.

One item that should be disposed of before going any further is understanding the motivation for making a systems change that would be erected on the new EDP machine base. This analysis of motivation presented the first of the Hobson's choices—a choice that grew out of the fact that for several years returns processing and revenue accounting have been mechanized operations in the Revenue Service. Does EDP merely offer an opportunity for substituting more sophisticated equipment capable of performing arithmetic and logic (in the sense of comparisons) operations at great speeds or can the tax administrator realize greater dividends with a new approach? Our decision was to put together a system that would move IRS in a new direction—not to change for the sake of change, but simply because EDP offers a capability which is badly needed in federal tax administration.

There is no question that there are advantages to a straight systems conversion from punched cards to magnetic tape. Without attempting to make an exhaustive listing, some of the more important ones are:

1. It truly would offer an opportunity for data processing in the optimum sense, since there would be eliminated the physical movement of data (in punched card mode) from machine to machine in order to sort, merge, compare, interpret or select from the same data.
2. Today's operations could be performed, in all probability, at a reduced cost.
3. Processing capabilities could be augmented considerably, with the result that larger quantities of data already available to the Service could be used more effectively.

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However, notwithstanding these things, there are other important benefits to our taxing system that are put within reach by EDP. The most significant of these benefits is the opportunity to create a master file of taxpayers who will be uniquely and permanently identified by an unchanging number that will be assigned to each account. This concept is the keystone of the new IRS system. In this case, master file means bringing together in one place (on magnetic tape) the information flowing from all transactions that affect the tax status of each taxpayer—and each related tax entity. Volume problems still can be messy, but no longer will it be impossible to effectively store identification, tax base and tax settlement data for each taxpayer, regardless of the current and projected size of our taxpayer population; no longer will taxpayer movement have an inhibiting influence on processing; and no longer will taxpayer filing practices prevent effective correlation of facts affecting his tax status. Thus, no matter where a return or other document is filed, prescribed information will flow to a central point to be processed against and thereby update the appropriate tax account—this to be done no matter where data recording may take place within the system.

### *Benefits from the System*

Centralized processing and centralized storage of data by tax entity open the door to another major benefit—the consolidation in a single integrated system of the major functions of processing, revenue accounting, enforcement and reporting. Thus, though there may be one primary incentive for recording given categories of data, these facts, once placed in the permanent storage medium, will be available for other purposes and in these situations data are subject to multiple uses for the cost of a single transcription. It follows that the greater the number of uses of any particular item, the lower will be the unit cost of recording that item for any single usage. Some of the situations which involve multiple uses of data in such an integrated system are:

1. The mathematical verification of all returns filed.
2. A systematic check on failure of individuals or business entities to file returns.
3. Disclosure of duplicate and fraudulent refunds, or outstanding balances due, for the same or a different tax for the same or a prior tax year before authorizing the refund requested.
4. The control and issuance of all bills and delinquent account notices through the master file.
5. The classification and selection of returns for audit examination.
6. The matching of data reported on information documents (Forms W-2, 1099, 1065) with corresponding data reported on tax returns. This would include validating prepayment credit claims—such as depositary receipt amounts with claimed credits for withheld income taxes.
7. The production of statistics of income and management information report data.

### *Organization*

Once the essential nature of the system was determined, the type of external medium to be used to store data became an extremely important element in IRS planning. This was not just a systems exercise. It was simply candid recognition of the new relationships that would come about in an organization whose processing functions are to be centralized while continuing to retain its

enforcement capabilities in decentralized locations. To put this matter in perspective some brief consideration of organization and document volumes is necessary.

Currently, the field organization of Internal Revenue Service is divided into nine regions, each responsible for seeing to it that all operations within the region are performed efficiently and effectively. There is a total of sixty-two district offices in all nine regions of the United States. Within these district office areas, there are several hundred field offices and it is in these district and field offices where IRS carries on the vast bulk of its enforcement work. Since many enforcement leads result from the processing and analysis of data contained in returns and other documents received annually by the Service, accessibility of the processed information to enforcement personnel is vital. Thus, on the one hand an evergrowing taxpayer population requires a decentralized enforcement arm whose locations appropriately recognize the facts of population density and distribution. On the other, the enormous paper work volumes, current and projected, generated by the millions of taxpayer entities that are constantly on the rise, indicate that the data handling job can be managed only by resort to a type of electronic computer whose capabilities and capacities induce centralization of processing.

How to bridge the gap? It certainly did not seem practicable to bring up to 450 million input documents into one place each year—to say nothing of the hundreds of millions of documents that would be output from the system. At the same time, it was clear that the proposed master file of taxpayer accounts could be maintained and used with maximum efficiency only with absolute centralization—that is one file in a single given location.

The solution for these varied problems has been a modification of organization that will eventually see a Service Center in each of the IRS Regions and a single Computer Center to be located at Martinsburg, West Virginia. All input and output operations will be performed at the Service Centers and at the Computer Center the master file of taxpayer accounts will be maintained and continuously updated. This arrangement will permit a distribution of documents in manageable proportions, considering the manual and other tasks that are a prelude to processing by an electronic computer. Thus, documents will be received by the Service Center from the district offices; the documents will be edited and data will be transcribed on punch cards and the punched cards will be converted to magnetic tape. These transaction tapes will be shipped to the National Computer Center for processing and updating of the master file; processed tapes will be returned to the Service Centers to produce the output documents called for. To complete the cycle, the tax returns and other input documents will be returned to the district offices for storage.

*File Storage Medium*

With the problem of organization settled, it was necessary to turn next to the question of the appropriate file storage medium that should be used within such an organizational framework. In short, which magnetic recording system, on balance, would seem to hold the greater advantage as a file medium for our proposed operation—in-line processing (random access) or sequential processing (using magnetic tape). The motivation to explore this matter was

largely a reflection of how to handle urgent references to master file taxpayer records. (In this connection, very little consideration was given to the magnetic drum because it seemed that, in the case of IRS, the cost of storing data would be excessive.)

There is no question about the appeal in instantaneously accessing a given file record in a system which uses random access equipment and magnetic discs. In this type of system, transactions are processed independently as they randomly appear. As a consequence, the master file is also accessed randomly. In sequential processing transactions are accumulated or batched and placed in the same order as the master file records that are to be updated. The ultimate decision was to use magnetic tape as the file storage medium which meant batching of transactions and sequential processing. Some of the considerations that supported this action are:

1. Master file records will be highly variable in length depending on each taxpayer's circumstances. Not only will they vary when first established, but as transactions are processed they will expand and contract at varying rates. This makes it virtually impossible to predetermine storage requirements by record and therefore to design a layout on magnetic discs that will be efficient for random recording and accessing.
2. Although individual tax returns may be filed between January 1st and April 15th, some 30 per cent of these returns are filed after April 1st. This taxpayer characteristic has the effect of batching returns and transactions and argues for sequenced processing if the Service is to effectively and economically process such an enormous volume of work in a reasonable period of time.
   a. Though the cost of randomly accessing a record to handle an emergency inquiry may not be great in and of itself, the advantage is lost by the very excessive cost involved in using the same method to post a master file with large volumes of routine transactions.
3. It is estimated that the master file of taxpayer accounts could contain up to 78 million records and 45 billion alphanumeric characters as of 1969. No random access equipment using magnetic disc was known to have sufficient capacity to handle such a volume.

Thus, it was decided that IRS had no choice. The nature of the proposed system and the volumes of data that would be stored made random access equipment impractical and too costly as a primary file medium. All planning thereafter was based upon the use of magnetic tape as the external storage medium on which the master file of taxpayer accounts would be maintained. In order to limit the need for inquiries to the master file, a system of output documents (e.g. index registers, settlement registers, lists to locate and facilitate pulling of returns) is planned for district office use. In this way, enforcement personnel in the district and field offices will continue to function efficiently with a maximum of information in hand in a centralized processing framework. Outputs for this purpose will be so contrived that field personnel will not be inundated with paper that cannot be used.

*Systems Installation*

Another early decision that had to be made, if planning was to proceed on an orderly basis, dealt with the question of systems installation. Should the system—embracing our total individual and

business taxpayer population—be installed everywhere at the same time? Or should a process of phasing be adopted? Similarly, should a taxpayer's account on magnetic tape be considered complete with the recording of a single year's tax data?

1. The magnitude of the system, the logistics problems that would be encountered in activating several new Service Centers and a Computer Center, phasing out one processing system while simultaneously installing a completely and dramatically new one argued for a discreet entry into the proposed system—one that would keep the conversion problems within manageable limits. For this reason, it was decided to install the business master file in a pilot region in the first year and the individual master file in the same region in the second year. On an orderly basis, all regions would then be scheduled for inclusion in the system by 1967.
2. However, the master file will not be complete until 1969 for the reason that it has been decided that each taxpayer record should contain data for three tax years. The rationale here is that the magnetic tape record is the prime file of continuity that IRS has needed for so long. In today's situation the association of documents and data for the same or different tax years can be a monumental task—and one fraught with uncertainties. The sheer mass of documents plus the filing habits of taxpayers make data compilation and association an almost impossible job. However, in a magnetic tape system an orderly process of data recording on a year to year basis brings about the desired compilation and association of related facts. It lays the basis for a prime file of continuity for millions of entities in the federal taxing system at the cost of editing and recording on magnetic tape—as accurately as possible—the facts furnished periodically by taxpayers and information reporters. Within this framework, and in an effort to put in perspective the need for data and the cost of reading from and posting an extremely long tape file, it was decided that a taxpayer record would be complete (in the magnetic tape prime file of continuity) when it contained a history of three years of tax base and tax settlement data (the current and two prior years). As the fourth year's transactions are processed, the data recorded for the first year *will be deleted from the magnetic tape master file.* (Such deleted data would be available for entry into retention registers maintained on microfilm).

### *The Data Recording Problem*

At the present stage of development, a determination of the data that should be transcribed from documents is one of the most difficult problems confronting the Service. Since IRS does not control the specific nature of the document preparation that will ultimately be input to the system (some documents may be hand written, some printed, some typed; taxpayers may use different pages, columns and lines to report the same kinds of information; some taxpayers may carry forward to the return information set forth on attached documents and some may not; etc.), the agency cannot expect, in the current state of the art, to use character recognition or optical scanning equipment. This is a desirable objective and one that is under study, but in the meantime data recording will be accomplished by the laborious processes of editing, key punching and key verifying information. No elaboration is necessary, except to say that this is very timeconsuming and

costly where the document and data volumes are as great as those which are handled annually by the Service.

Because of the factors of time and cost, identification of the transaction data that will be punched for later conversion to magnetic tape must be a very selective undertaking—one that balances cost against need and usefulness. This is true not only with respect to the data that will be machine processed as transactions, but is equally true in the case of the data that will be retained in the master file for the three-year period (passing a magnetic tape file of 78 million records can also be needlessly expensive and wasteful where the incidence of change of a recorded item is very small; also, summary information may suffice for file purposes after the details of transactions have been processed). To cope with this problem, there are some criteria which will at least help to define our data recording boundaries. These are discussed below, although no effort is being made here to assign a position of relative importance to anyone of them.

1. *Identification*—There should be enough information recorded
   a. To locate the proper master file record in the magnetic tape file.
   b. To communicate with the taxpayer.
   c. To identify and communicate with related tax entities.
   d. To provide for electronic communication between the business master file and the individual master file.
   e. To facilitate a tracing back from the magnetic tape file to the physical document from which the transaction data were taken.
   f. To classify records for selection for any purpose and for grouping with other records.
2. *Mathematical verification*—There should be enough information recorded
   a. To compute the amount of tax to be paid.
   b. To compute billable and refundable amounts.
   c. To eliminate error from data to be recorded in the Master File whether or not such elimination results in a change in the settlement amount.
   d. To establish amounts of loss for use in processing transaction data in subsequent tax periods.
3. *Validation*—There should be enough information recorded
   a. To verify data reported on tax returns with corresponding data reported on information returns.
   b. To compare information reported by related tax entities.
   c. To verify information reported in estimates or tentative reports with that contained in final reports.
   d. To carry information backward and forward into other tax periods of any tax entity.
4. *Settlement*—There should be enough information recorded
   a. To reflect settlement money amounts (assessments, abatements, bills, refunds, payments, interest, penalties, depositary receipts).
   b. To reflect taxpayer generated amendments as well as adjustments based on audit and other enforcement action.
   c. To reflect delinquency status.
   d. To provide for certification of the account for legal purposes.
5. *Audit*—There should be enough information recorded to identify those records that meet the criteria to be used in classifying returns for examination.
6. *Reports*—When the specific document items are described which meet the above criteria, it will be possible to determine what additional data re-

> cording may be necessary to develop Statistics of Income and management information reports.

The problem is brought into bold relief by analysis of a document such as the U. S. Corporation Income Tax Return, Form 1120. Using essentially the same criteria as those described above, proposals have been made to record a low of 75 data words (or items or fields) and a high of 272 such items. There is another proposal which would result in recording of 160 data words. All of these estimates of data needs from all Forms 1120 were arrived at independently, indicating how much reconciliation is necessary since the proposers believe their positions to be quite valid in the light of the stated criteria and Service requirements. If the significance of this matter isn't apparent yet, it becomes increasingly clear when the data words are translated into alpha-numeric characters.

Estimates have been made of the frequency of occurrence of data words and field sizes, making it possible to assign some order of magnitude to the number of alpha-numeric characters that could be recorded from Forms 1120 filed by that segment of the taxpayer population responsible for this type of return. Using these estimates, the extent of data recording could range from an average low of about 340 alpha-numeric characters per document to an average high of 1100. Omitting coding and editing costs, the expense of key stroking could range from something around $350,000 to a high of about $1,250,000 for all Forms 1120. Thus, it is abundantly clear that the final decisions on the data to be recorded must be very carefully made with an eye always to the utility which an item may have in relation to the cost of recording that item. At this writing this is a top priority project in the Service.

When speaking about the information that will be transcribed from Form 1120, an area of special interest is the balance sheet. However, at this stage of development of the system, it isn't possible to be very specific. It can be said that data from Schedules L and M will be needed for master file processing, but also presented here are the same stresses involved in balancing costs against usefulness of the information in a machine system. Current study of this matter indicates that, apart from machine generated items, as many as twenty-three data words might be transcribed from both schedules. At present, this will satisfy a number of the tests under development for machine classification of returns for audit examination—a project that will require a very intensive effort to perfect and one whose success will be measurable only in terms of prospective results.

### *Validation and Verification*

Within the conceptual outline drawn thus far, there is every reason to believe that the information reporting system will finally find its intended place in tax administration. As of 1969, it is estimated that IRS will receive about 250 million information documents (Forms 1099, W-2A, W-3 and 1065). The sheer magnitude of sorting such a volume of documents and then locating the tax return is staggering. Electronic data processing equipment puts us on the threshhold of effective management and use of such document volumes.

Why on the threshhold? Even with magnetic tape drives that will read or write information at speeds exceeding 100,000 characters per second and a computer that will perform a comparison in microsecond time, this is not

enough. The equipment has to be complemented by a system that will facilitate finding all the significant information that is a part of each tax account. Thus, there is underscored once more IRS's need for a master file—a file that does not inherently rely upon an identification system that is subject to a variety of mutations, but rather one within which each of the 78 million records can always be searched and found in the same way. It follows, as indicated earlier, that this means the assignment to each taxpayer of a discreet, unchanging number to identify his account—one that must be used on each input document that pertains to his account.

With the electronic equipment that will be installed and a master file using the identification system described, it will be relatively easy to sort transactions in the same order as the taxpayer records in the file. Once the transactions have been so ordered, comparing tax return data with that which is furnished by the information reporter is also a very manageable job. Hence, the sorting, merging and comparing operations that would be next to impossible with any equipment short of data processors where the volume of documents (tax and information) is in the range of 350 million, become practical with the ADP master file system.

This application, like any in an EDP system, has a price tag in the form of editing, transcription and computing costs. Unlike some, however, this application has a positive value in that it is an enforcement device that will improve our voluntary taxpayer compliance system and will help the Service to narrow the gap between income reported by taxpayers and that which various studies indicate should be reported. In the instance of dividends and interest alone, this gap has been estimated to amount to nearly four billion dollars. Translated into increased revenue, the potential tax yield is many times the cost of identifying cases of nonreporting or under reporting of both types of income.

Mechanically, this matching and validation operation is not complex in a processing sense, but enforcement is another matter. It would be a mistake to oversimplify and suggest that this or any other tax enforcement process is easy to handle and administer. However, this proposition differs from that which involves the pulling of tax returns for field audit in that the initial contact with the taxpayer in these cases can be the result of high speed printout of an appropriate communication. In fact, it does not seem unreasonable to anticipate that a substantial number of these cases will be cleared without taxpayer contact or with no more than the taxpayer's voluntary appearance at a field office to dispose of the matter. Without experience, it is difficult to estimate the extent to which follow up enforcement action by IRS may be necesssary. Eventually, as the system is perfected, the volume of cases of non-reporting or under reporting should decrease substantially, but neither this nor the additional revenue yield that will result from improved taxpayer compliance means that machine matching of tax return and information return data can be abandoned. The use of computers for this purpose inevitably must be continued as an enforcement device in tax administration.

In order to round out the discussion on this phase of the subject, a brief reference to the form of external reporting is in order. For a number of years, information returns have been paper documents. Recently, some in-

formation reporters have used punched cards. Although cards are easier to handle, in neither case is the problem of sorting and association easy. However, the master file system offers future possibilities that should afford some relief to both information reporters and IRS. Essentially, I am referring to the receipt of data in machine readable form. This can come about in one of two ways. First, an organization using electronic data processors could report wage, dividend or interest information in magnetic tape mode. Such a tape exchange raises a question about compatibility of equipment and whether the payer's magnetic tape can be used in the IRS data processing system. However, this should not be an insuperable problem. The second possibility is the use of character recognition equipment to convert printed data to magnetic tape—whether the printing is on cards or hard copy. Obviously, this pre-supposes the availability of character recognition equipment somewhere and in the case of IRS this may well be some little time from now. In this sense, the use of magnetic tape has much earlier promise as a medium for information reporting, but some caveats should be noted even now:

1. IRS is not prepared to accept and use this mode of reporting just yet.
2. More stringent reporting requirements will have to be imposed on payers. Unedited or poorly edited tapes will only swell and clutter up the "mismatch pipeline." IRS would be badly bogged down in such circumstances since there would be no source document that could be used to correct the error and cure the mismatch.
3. Specifications dealing with arrangement of the data on magnetic tape will have to be developed.

However, notwithstanding some of the problems, the goal is worth striving for and it is high on our project planning list.

### *"Push-Button" Access to the Master File*

In the early part of this discussion it was indicated why IRS was under constraint to centralize its processing operations and to use magnetic tape as its external file storage medium. Since enforcement activities can best be carried on in a decentralized setting, it was further indicated that the availability of file information to field personnel will have to be accomplished through a well planned system of output documents. However, in each month seemingly there is a new advance announced as part of a steady stream of events making up a remarkable technology progress. Is there any hope that personnel located at decentralized points across the country may access a centralized file on some sort of "push-button" basis?

This question cannot be answered unequivocally in the negative. The problem essentially is one of communications and the nature of the master file itself. Although there is available today equipment and communications media and techniques which would permit rapid transmission of large volumes of information to many terminal points, there are two hurdles which are formidable barriers to the achievement of the kind of data communications network that is suggested by the question that has been posed.

First, there is the matter of costs. In today's state of the art it is relatively expensive to transmit electronically *large* volumes of data over an area as large as the United States. In the case of the IRS system it is submitted that currently

there is an adequate and more economical method of satisfying the needs of enforcement employees located at decentralized points and an effort will be made to develop this theme in subsequent discussion. In this connection, it is important to distinguish between routine access of the file for informational purposes and the electronic transmission of transaction data from the Service Centers to the Computer Center and output data from the Computer Center to the Service Centers. We are talking here of the file access problem, although it may be important to note in passing that the electronic transmission of transaction and output data should also command our interest, attention and study. At the moment, the problem of economics is a formidable one. Consider a system in which 40 billion tape digits of transaction data will be moved each year from nine locations to a central point. Even though tape-to-tape transmission by microwave is technically possible, the factor of cost has to be heavily weighted in a system in which a few additional days of transmission time are not critical. This problem also will be studied carefully in order that we may develop the most effective kind of communications system to serve our long range needs, according to each factor an appropriate weight for balancing against all other factors.

The second problem is much more pragmatic. We have referred to one estimate that indicates that in 1969 the Master File will be made up of 78 million records containing about 45 billion alpha-numeric characters. Our assumption thus far is that the size of this file precludes processing more frequently than once each week. In order to do this, and apart from the maximum of 27 small scale computer systems and an effective number of 18 high speed printers (600 lines a minute) that will be located at the nine Service Centers, the planned installation for the Computer Center includes two large scale data processors with 20,000 words of memory each and four microsecond access time, as well as 28 very high speed tape drives. Even with this kind of capacity, speed and power, it is estimated that about 900 computer hours will be required in the maximum processing month. Thus, there is no evidence yet that Master File processing more frequently than once weekly is practical or justifiable.

What can be done? There are some output documents for which there is currently a predictable need. Periodically updated index registers will be indispensable in meeting district office requirements. With such registers, it will be possible to determine taxpayer identification account number when name and address are known; to determine taxpayer name and address where the taxpayer's identification account number is known; to determine document locator number when the correct taxpayer identification account number has been established. This last will be most important since the document locator number will be the means for tracing the document itself whenever this should be necessary. Another useful output document will be the Settlement Register which, by account number and surname, will show, by tax period, information pertaining to assessments, applied credits, balances due and refunds scheduled.

Other printed outputs in the category just described (master file information that can be the subject of frequent inquiry) can also be provided. However, in order to avoid a needless flood of paper to the district offices, studies will have to be conducted in order to deter-

mine the frequency with which other kinds of file data may be required by the field. At that, the registers themselves comprise a considerable volume of paper to handle and effectively use, but it can be done. In addition, equipment is now available which makes it possible to produce a microfilm record directly from magnetic tape or the electronic computer itself. This is done at very high speeds by using a cathode ray tube to display on its face readable language which has been decoded from the " bits " on the magnetic tape. The result is recorded on microfilm at ratios that reduce large piles of paper to a small quantity of film magazines (e.g. about 20 million characters can be recorded on a single 100-foot reel of 16mm microfilm). The advantages are obvious. Large quantities of file information can be furnished to the district offices in compact form and in a mode which makes it readily and quickly accessible on microfilm readers that can be located at the decentralized points.

### *The Enforcement Work That Will Be Generated in an ADP System*

It seems reasonable to expect that the system which has been described could produce a considerable increase in enforcement activity. The question is what plans should be made to cope with the problem. Although it has a platitudinous sounding ring, the proverbial ounce of prevention should prove very helpful. The Service has an effective education and taxpayer assistance program and these should be exploited to the fullest. If the entire taxpayer population can be persuaded that this system is designed to broaden the tax base by insuring that every taxpayer carry the fair share of the burden which is his and that he realize that it will be increasingly more difficult to avoid this responsibility, the level of voluntary tax compliance is bound to rise.

Despite improved taxpayer compliance, there will still be delinquent return filers, delinquent accounts, mathematical errors, evidence of non-reporting and under reporting of income, etc. As it happens most enforcement problems of this kind are susceptible of resolution initially by written communication in the form of printout from the computer system. However, they will not all be so resolved. There are both cases of no response and unsatisfactory response. In these instances, there is a secondary form of communication which will be used—namely the Office Collection Force of the District Office which has enjoyed a considerable measure of success by using the telephone as well as correspondence to follow up on these taxpayers. Where this fails, there is still the Revenue Officer to make personal contact with the taxpayer and whether the work force will be sufficient to cope with the workload is next to impossible to forecast now.

The other enforcement activity that will be affected by this data processing system will involve the audit function as it pertains to those taxpayers whose returns are selected for examination. Here again the Office Audit work force should be of considerable help, but as to the residue of cases that require field audit attention and personal contact with the taxpayer, it is difficult at this time to even describe the dimensions of the problem. Fortunately, the audit work force is so distributed among posts of duty as to give appropriate recognition to taxpayer centers of density. However, if the workload generated by the machine application of criteria to the returns produces a volume of cases that exceeds Audit's capacity over-all or

by post of duty, other measures will be necessary. The most significant will be studies to constantly refine the criteria used in the classification process so that the volume of cases selected for examination from the various taxpayer classes can be more nearly tailored to our manpower resources. Finally, the system can be utilized to select a scientific sample of returns for examination to serve the dual purpose of assuring compliance efforts in all taxpayer classes and indicating the problem areas in need of special enforcement efforts.

### *Conclusion*

Thus, there is very little doubt that automatic data processing will have a marked effect on federal tax administration. However, it should prove a welcome change since it will furnish to the tax administrator a tool which is badly needed to cope with today's paperwork volumes. Moreover, it will afford to the administrator the opportunity to function in a way that every taxpayer has the right to expect. Benefits should accrue to all who are touched in any way by our taxing system.

## DISCUSSION NOTES

THE group first explored the possibility of easing the data presentation or keypunching log jam. While optical scanning devices were thought to show promise it was acknowledged that, even assuming the existence of economical equipment, current reporting forms and taxpayer handwriting would pose problems. Whether or not taxpayers would be able to do their reporting on machine readable media (cards or tape) was also examined and the principal obstacles cited were format and equipment compatibility.

Much comment was stimulated by the suggestion that, given

1. that most taxpayers earn income via wages, salaries, interest and dividends, and many use the standard deduction, and
2. that in the near future there may be withholding with respect to all these income items,

it might be possible to by-pass the filing of returns completely (except for exemption data) in a great number of cases. Machines, it was suggested, could conveniently combine the data, compute and issue bills or refunds. Some viewed the suggestion as somewhat radical but theoretically possible, while its proponents denied that it was so new and warned that it, and kindred ideas, ought to be considered now before less efficient procedures become so entrenched as to make future adoption impossible even with EDP. This led to some more general caveats on system stagnation which it was said arises from either fitting new tools to old procedures or not putting some flexibility into the new procedures to allow for reasonably plausible future developments.

Discussion next centered on the flexibility of the IRS system. What were the toleration limits with respect to changes in substantive law? How will the system handle situations such as the one posed when divorce creates two tax-

paying units where there was only one before, due to the joint return provisions of the code? A largely wait and see attitude prevailed on changes in the law, and the matter of current complexities was said to be still principally in the study and planning stage.

Other discussion centered around the problem of deciding the types of input for a Master File system. It was said that the introduction and adoption of EDP offered almost unlimited opportunities for the manipulation of data supplied the IRS. Some consideration of these different end uses of the data were necessary before the exact nature of the input could be decided. To this end several objectives of the system had been spelled out:

1. The mathematical verification of all returns filed.
2. A systematic check on failure of individuals or business entities to file returns.
3. Disclosure of duplicate and fraudulent refunds, or outstanding balances due, for the same or a different tax year or a prior year before authorizing the refund requested.
4. Control and issuance of all bills and delinquent account notices through the Master File.
5. The classification and selection of returns for audit.
6. The matching of data reported on information documents with corresponding data reported on tax returns.
7. The production of statistics of income and management information report data.

These objectives plus the inherent limitations of the hardware place certain constraints upon the amount of data to be included in the Master File.

It was further emphasized that sequential processing on magnetic tapes gave greater flexibility to the system. The number of alpha-numeric characters per taxpayer would not be constant and there would be differences between tax years for the same taxpayer. Also, changes in the tax laws would be accommodated much easier through the use of magnetic tapes. Little concern was voiced over the fact that the Master File storage medium could not be accessed randomly as it was shown that enforcement officers would suffer no greater delays in reciving information than they do currently.

The last topic explored was the matter of taxpayer identification via the unique number. Two principal factors were seen as forcing the IRS to build on the social security numbering system:

1. The already widespread use of the number coupled with an executive order to the effect that, where possible, the system should be used, and
2. The cost of and expected resistance to a "numbering" of citizens.

The inability of IRS to devise and assign its own numbers was thought to be regrettable since such numbers would offer significant advantages. For one thing a check feature could be incorporated into the number itself. In addition, the numbers could be broken into categories, such as income, geographic location, occupational and so forth, and later data could be compared with the numbers to discover trends in income, taxpayer movement, and such.

# EDP AND TAX ADMINISTRATION IN NEW YORK

## DEVELOPMENT OF THE PROGRAM

JOSEPH H. MURPHY *

IN MINNEAPOLIS at the National Association of Tax Administrators' conference last summer someone suggested that if it were not for the existence of EDP, no unit of state or federal government could afford either the space or the manpower required to handle the increasingly complex and multiple operations involved in processing tax returns that run into the millions. In New York State, as I'm sure many of you are aware, we are still groping for better solutions to our particular problems. In a way of speaking, we are just learning to walk—if you were to compare our operation, let's say, with the use Dr. Edward Teller is making of electronic data processing methods and capabilities in teaching "Unconventional Uses of Nuclear Energy" at Berkeley. The uses and capabilities inherent in EDP present a fascinating array of possibilities when you consider that they are of equal interest to one of the world's leading theoretical physicists and to a state tax department concerned primarily with much simpler problems and much less complex solutions.

A tax administrator, among his responsibilities, must see that inequities are removed, that each taxpayer pays no more or no less than his rightful share of the cost of government, and that the machinery and manpower for tax collection is used to its maximum capability. With New York State, as with any governmental unit charged with tax administration, the problem of evasion was one of our major concerns. This was especially true in the days before we adopted an income tax withholding system of collection.

There were two kinds of state tax evasion which we had to contend with. One might be called "total evasion" and the other "partial evasion." In the first instance, there was a hard core of persons who had never paid a state tax. In the second, there were many taxpayers, we were sure, who either by accident or design or ignorance of the law were minimizing their tax liability by taking improper deductions and making improper exemption claims.

This situation had been going on for years and had stretched from one State administration to the next. The backlog of known cases of partial evasion was growing at an alarming rate. Ideally, of course, the solution would have been to audit each return, but this was wholly impractical and our Income Tax Bureau had to settle for auditing those returns which promised the greatest yield.

Experience has shown that the great majority of taxpayers are fundamentally honest and desire to meet their tax responsibilities in full. While this is all to the good, it meant that the task of finding those returns which required audit was an extremely costly and time-

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consuming process. Consequently, our yield per return examined was extremely small.

Early in the 1950's, we made a survey of the Audit Section of our Income Tax Bureau. This study showed that a steadily increasing volume of tax returns would result in an increased backlog of unaudited returns. In some cases, we would be confronted with the expiration of the three-year statute of limitations. To make the solution to our problem more urgent, the number of income tax returns received had increased from 2.7 million in 1946 to about 5.3 million in 1957. This growth of virtually 100 per cent in the number of returns filed was reflected in a corresponding increase in the backlog of work piling up on our auditors.

Budget stringencies from one year to the next had prevented us from getting the manpower we felt we needed. Even before the Rockefeller Administration took office, it was quite apparent that something would have to be done to correct this situation.

In several ways, the introduction of a withholding program for the collection of our personal income tax was a blessing because it effectively brought to an end the major loopholes that permitted the "total evasion" I mentioned earlier. However, it also brought another increase in the number of tax returns filed—an increase of nearly a million returns from 1957 to 1959. Without the help provided by electronic data processing, we could not have handled the increase in the number of tax returns filed, and we certainly could not have hoped to keep abreast of our auditing work load.

Annual studies of our personal income tax for the last 13 years have shown several interesting things that have helped us devise a means of translating information to the common denominator of norms. The analysis showed, for instance, that deductions accounted for slightly less than 12 per cent of total income reported in 1947. Ten years later, deductions accounted for almost 15 per cent of total income reported.

The creation of norms was the central feature in the development of the entire audit selection procedure. The goal was to eliminate as an audit possibility those returns on which the taxpayer's claim for each itemized deduction fell below the pre-determined norm. On the other hand, if the taxpayer exceeded any of the norms, his return would be selected for audit.

The selection of a return for audit on the basis of the norms does not necessarily mean that the taxpayer has made an improper or unsupportable claim for deductions.

What is a norm? If a taxpayer earned $10,000 and claimed a deduction for contributions of $100, this would not be considered unusually philanthropic. But, if he claimed a deduction of $1,000, this would raise some doubt as to whether the taxpayer was seeking to minimize his tax. The norm for contributions is, obviously, neither $100 nor $1,000. We sought that level which was reasonable for a taxpayer in a given marital situation and in a given income class.

Once we had the norms established and were able to get our programming set up on our computer, it was a relatively easy matter to improve the efficiency of our entire audit operation—and to be selective about those returns which were chosen for audit so that each audit was productive.

I have already referred to the annual

personal income tax surveys of the Research Bureau. The analysis included the usual information on sources of income and residence, but refined the data on taxpayer's marital status and deduction claims. Our research staff was able to classify each major deduction item by the marital status code, segregating married taxpayers filing joint returns from married taxpayers filing separately. With this expansion of coverage it was feasible to develop norms of sufficient efficacy to mirror the changes in taxpayer deduction patterns appearing in different income levels and marital categories.

It is not realistic for a single person in a low income bracket to be expected to contribute as much to charity as his counterpart in a high income bracket. On the other hand, at the same or similar income levels, single taxpayers might logically be expected to have contributions greatly in excess of a married man with a large family. Married persons are more apt to own their homes than single persons and consequently have larger deductions for interest payments and real estate taxes. Medical expenditures by childless couples or single persons are, normally, much lower than such expenditures by families with children at corresponding income levels.

Significant variations in these deduction patterns can be distinguished between married taxpayers filing joint returns where, commonly, there is only one breadwinner in the family, and married persons filing separately where both spouses are gainfully employed.

A basic feature of the selective norm concept is that, except for the net to gross ratio, the norms are in dollar amounts which permit the flexibility necessary for effective operation. This is important because experience has demonstrated that there is considerable variation in typical deduction patterns. Thus no single dollar value can be used in designing a screen through which to filter the cases with the greatest potential while rejecting the others.

Data supporting these observations on the behavior of taxpayers served as the foundation for norms applicable to gross income groups and their constituent marital status categories: single taxpayers, married taxpayers filing separate returns, and married taxpayers filing joint returns.

It goes without saying that, regardless of the precision with which the norms function, they are of little administrative value unless the returns selected for audit can be properly processed by the audit personnel. The selection of audit cases by manual methods was deemed impractical, since it would involve comparing each appropriate deduction or income item on each return with the established norms, an extremely unwieldy and costly method. The use of conventional machine accounting equipment would relieve audit personnel of this burden of screening each return but, at the same time, would generate numerous other problems.

Use of an electronic computer was clearly indicated in order to solve this problem. The analysis of each tax return as well as the determination and selection of those cases which required audit was feasible only with the computer. In addition, punch cards could be simultaneously prepared which would identify for the auditor the item or items needing further scrutiny.

The processing equipment we now have in operation is able to verify the taxpayer's arithmetic, check against norms, issue refund checks—at the rate of between 80,000 and 100,000 daily—

address and mail those checks, and do a number of other things which you will hear about in more detail a little later.

As might be expected, the introduction of mechanization or automation through use of the computer met with some resistance by the audit personnel. Fear of losing one's job or of demotion is naturally to be expected under these circumstances. When confronted with this radical departure from established procedure, our auditors and administrative staff were naturally most reluctant to foresake the long established extensive audit for what to them seemed an uncertain method which might fall short of predicted results.

We did, however, eventually persuade our people that the selection program was designed to bring to the auditors attention those returns which had a higher probability of larger assessments. It merely separated the chaff from the wheat. The system we inaugurated provided the auditor with a chance to apply his skills in greater depth and broader perspective and enhanced rather than decreased his prestige.

What has EDP meant to us from a broad administrative point of view? What has it meant to the taxpayer? How has it saved us money? What have been some of its broader benefits?

Some of those questions cannot be answered glibly or tied directly to a dollar saving in the costs of operating the State Tax Department.

Some of them will have to wait for answers until we have had a longer time to evaluate the results of EDP.

But of this much we are sure:

From an administrative point of view, EDP has made it possible for us to pull ourselves out of a deepening hole and halt what had become a dangerous and costly inability to keep up with the vitally important job of auditing returns. From the standpoint of revenue loss alone, this in itself has been well worth the expense and the thousands of man hours that have gone into perfecting the system to meet our requirements.

The taxpayer has been benefitted through better service, faster payment of his refunds, less delay in correspondence.

Admittedly, withholding has brought enormous benefits in the administration of our state income tax, but EDP has to be given credit for making it possible to make refund payments this year to an estimated four-and-a-half to five million taxpayers in even less time than it took us to make three million last year. This will be accomplished in part through the use of more sophisticated processing equipment.

EDP was tailor-made for the withholding program. We were able to reorganize our Income Tax Bureau for more efficient operation only because of the existence of electronic data processing equipment. We increased the number of District Tax Offices from seven to eleven to give taxpayers better and more localized service. We set up a key punch center in Schenectady where all returns are sent for interpretation to punch cards. We established a data processing center in North Albany.

Then followed a massive public education job to inform over six million taxpayers in the state how to use these new facilities.

We are by no means in the sophisticated strata of EDP occupied by such people as Dr. Teller, but we are convinced that the advantages of electronic data processing are very real, very prac-

tical and very much worth our further exploitation.

To underline our conviction on this subject, I will say for the first time publicly anywhere that we have gone so far, in the New York State Tax Department, as to set up a Data Processing Bureau which will be a completely integrated unit capable and qualified to evaluate new methods, new procedures, new techniques, so that we may avail ourselves of the advances which, in this business, seem to be coming along faster than anyone can keep track of them.

## DERIVATION AND APPLICATION OF NORMS IN SELECTING INCOME TAX RETURNS FOR AUDIT

CHESTER B. POND *

Modern tax administrative machinery is founded on the premise that most taxpayers are basically honest. However, as Commissioner Murphy has suggested, there are always some who, through inadvertence or design, minimize their tax liability. Hence the need for adequate enforcement through audit. In seeking out the few who fail to pay their full share, traditional practice in New York State called for extensive audits involving nearly all returns. The increasing number of returns led to a growing backlog in the work load. Budget limitations and pressure of space, time and staff restrictions dramatized the need for a selective audit program that would realize the optimum results from audit operations.

The Bureau of Research and Statistics, long before operational problems forced the issue, had been interested in the selection and use of norms. Since 1948, we have conducted annual surveys of the personal income tax returns, based on a relatively small sample, stratified as to amount of tax in the early studies and as to gross income in the more recent surveys. We were therefore able to observe the changing pattern and rising level of deductions by income classes and by marital status. Deductions offer one of the greatest avenues for minimizing tax liability and it is evident that, to be most successful with the available staff, the audit program should concentrate on taxpayers whose deductions are excessive in relation to others in a comparable income classification. Such a concentration of effort would reduce the number of cases selected for audit without impairing, and hence presumably improving, the revenue potential. Up to this time, suggestions of this nature to the audit agency were made on the basis of using conventional mechanical equipment.

When the critical stage in audit operations was finally reached and it was clearly impossible to continue on the old basis, the Research and Statistics Bureau was requested to derive norms for use in selecting for audit the 50 per cent of returns with the greatest revenue potential. This volume was all that could be handled by the existing audit staff. It was fortunate that the development of electronic computers had reached the

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stage where they could be employed in the derivation of the norms and the various tests required to insure their proper operation, since it would have been impossible to meet our deadline without this equipment.

Generally, the electronic age has been heralded as improving the lot of the average man and it may seem far-fetched to assert that taxes play a part in this picture. It is a fact, however, that EDP is an important part of the effort to assure that your neighbor pays neither more nor less than his rightful tax, even as you and I.

The first step in deriving the norms was to run the deduction items indicated on the cards punched from our income tax statistics study through the electronic computer to determine a frequency distribution for each deduction. Simultaneously, the computer was programmed to calculate the ratio of net income to gross income. This is virtually a master norm, since it is a composite of the other norms and selects for audit those returns with deductions so spread among the various categories as to escape detection on the basis of individual norms.

For the first test, the median value for each deduction and the "net to gross" norm were employed. These norms were applied against a sample deck of income tax returns on the electronic computer and selected considerably more than the 50 per cent target. Since half the cases were selected on the net to gross norm, each successive norm applied to the rejected group added to the volume selected. Three tests on the computer were conducted before the desired objective of 50 per cent was attained. In many instances, it was necessary to go as far as the seventh decile to reduce the volume sufficiently.

Next, the computer was used to test the extent of overlapping among the norms. This test indicated that it was possible to eliminate two of the norms without significant impairment of the selective process since, in most instances, these norms coincided with the net to gross ratio. This produced a savings in related key punch time, computer time, and programming.

After a satisfactory solution of the volume problem, protection of revenue yield was of paramount concern. For a smaller number of cases audited, assurance was needed that the dollar amount of assessments would not decline. Indeed, logic pointed inescapably to increased revenue because of the greater potential of the selected returns. The audit agency furnished a representative sample of cases already assessed and these were processed through the computer to test whether they would have been selected for audit. The results indicated that the dollar amount of assessments on the selected cases represented five-sixths of the total on all the cases. Since the audit agency was handling only two-thirds of the cases on a nonselected basis and therefore was producing only four-sixths of the potential, the application of the norms method to all returns would produce five-sixths of the potential, an imputed gain of 25 per cent.

The review of selected cases already assessed sufficed to give the "go-ahead" on the change to a machine basis for audit selection. The first step in the audit selection process is to route the tax returns to a key punch unit where a special input (screening) card is prepared. This card contains a code for the marital status of the taxpayer and data on gross income and on each of the items to which a norm is applied. When the computer selects a return for audit be-

cause one or more of the norms is exceeded, it prepares an output (audit selection) card and automatically punches in the reason for selection. This output card is associated with the tax return and forwarded for audit. Action taken by the auditor is manually indicated on the output card and the data are eventually punched in. This provides a source document for study and evaluation through the use of machine equipment.

At this stage it was necessary to convince ourselves and the audit agency (but not necessarily in that order) that the volume would be within reason and that the rejected cases would not cause any undue revenue loss. As soon as the program was in operation, an immediate test was made of the " rejected " or " non-selected " cases. These rejected cases were sent to the audit agency for an intensive review. The " action ratio," or the percentage of cases audited which resulted in an assessment, was less than one-fifth of that for the selected cases. On a dollar basis, the results showed a negligible loss on the rejected cases, considering the proportion of cases actually assessed and the relatively small average assessment involved. Again, this loss was more than offset by the greater productivity in the cases selected by the norms.

Continuous measurement and evaluation of the program is extremely important. As the cards were being fed through the computer for audit selection, derivative statistics were obtained as to the number of cases selected, the norm involved in each tabulation, by income group and by business and non-business status. The fact that almost 200 program positions were used for statistical purposes emphasizes the extent to which our work has been accepted by those who were once skeptical of this endeavor. These statistics provide the underlying basis for making changes in the norms as requested by the audit agency in cases of desired volume adjustments.

A word about business and non-business norms. Theoretically, there is much to be said for gross profit ratios, etc., but this type of information was not available from the income tax survey which was the basis for all other norms. Actually, we used an arbitrary total of gross receipts, which differed depending on whether or not the taxpayer was subject to our novel unincorporated business tax. This was in addition to the deduction norms already described. Even on this crude basis, evaluation of assessments against the cases selected showed a significantly higher average assessment per case than for the non-business returns.

It is no surprise that the potential for assessment varies in accordance with the size of income. Our norms reflect this consistently in the non-business and business categories. A preliminary evaluation of the marital status, which is one criterion used in setting up norms by income groups, indicates a good fit with respect to the proportion of assessments and the amount of assessments.

Because of the interrelationship of the various deduction items, it is not surprising to learn that assessments are often made for reasons other than that for which the case was originally selected. This points up the pattern of deductions employed by certain taxpayers in their misguided efforts at tax minimization.

In a broad sense, our work in applying norms for audit selection is still in

the early stages. It is a continuing function, requiring close cooperation between staff and line personnel. At this stage, however, it is possible to make some general observations on the results of the program. For the first complete fiscal year of operation, the total number of assessments from desk audit and average assessment increased by about one-third. It must be admitted that some part of the increase was due to the fact that the electronic computer checked the taxpayer's calculation of his tax, but this would not have been feasible except as a byproduct of the use of norms.

The success of the audit screening process led to a request by the Income Tax Bureau for a set of refund norms. The Research and Statistics Bureau provided criteria to assure that no outsize refund would be mailed to a taxpayer before the return was properly screened. An adjunct of this problem was to provide a means for detecting some misguided taxpayers who inadvertently reported their federal withholding.

Our electronic computer installation is a joint venture of the Income Tax Bureau and the Research and Statistics Bureau. The overriding importance of line functions has at times necessarily delayed the less urgent need for statistics, but the cooperation between the bureaus has been of a high order. The same computer, which used the initial punch card data from the income tax sample study, now makes it possible for the Research and Statistics Bureau to improve the quality and quantity of the data by the speed and accuracy with which it performs computations, aggregation and inflation. Thus, the wheel has gone full circle.

## DISCUSSION NOTES

The first question raised was whether it was possible for a taxpayer to become familiar with the selection criteria and thus become able to evade taxes and be sure of escaping detection. Two factors were seen as mitigating against this:

1. The norms are kept secret, and
2. They are constantly being reevaluated.

Some questioned the efficacy of the secrecy attempt, personnel turn-over being cited as one area of leakage. Further discussion made it abundantly clear that there was no general agreement on how the norms were to be evaluated.

Fault was found with putting emphasis on the assessment/cost ratio. It might be that the criteria used would reject great segments of the taxpayer population whose assessments would be low individually but high in the aggregate and more importantly, the failure to audit might reduce voluntary compliance within those groups. This indicated to some that these criteria had to be much more complicated functions of many more variables if the twin objectives of greater over-all yield and greater assessment yield were to be realized.

Discussion then moved to the impact of average deduction statistics on the efficacy of norms and voluntary compliance. It seemed to be generally conceded that such averages gave a strong push in the direction of taxpayer corner cutting and tended to undermine the norms. The norms were also seen as not being able to cover perhaps the biggest

area of revenue leakage, i.e., excessive exemptions. The ability of EDP to match information from various sources was seen as offering future possibilities for increasing compliance in this area.

There was discussion concerning the purpose of the desk review and audit procedures in general. A distinction was made between maximizing revenue and securing greater compliance with the revenue laws; although it was pointed out that securing greater compliance probably would lead to maximizing revenue. Revelant to this discussion was the general question of whether random sampling would accomplish the same task that New York State had started out to do, with less work and expense. While conceding that random sampling had not been fully investigated, it was pointed out that the method of establishing and reviewing norms was essentially a " random sampling " process.

In place of norms, others suggested that a purely random audit might be best under the theory that the impact of enforcement activity on voluntary compliance is more significant than audit assessment amounts. This idea ran afoul of a practical political hurdle, namely, that most appropriations for auditing and enforcement activities are justified on the basis of the assessment ratio. The proponents of random audit conceded the point but classified this as a problem of demonstration, and sugested that EDP might be able to give some assistance in the solution. That is to say, they felt that EDP might be used to construct a model which would gauge the dollar effect, in terms of net revenue, of random versus selective audit. In summary, the burden of proof seemed clearly to rest on the random audit theory and it was agreed that selection of some type was necessary.

Finally, the question was raised: What is the purpose of EDP in this system? Is it to facilitate paper handling or to facilitate audit selection? It was pointed out that on the federal level, the objective was to facilitate paper handling; audit selection became a secondary objective. However, in expediting paper handling a valuable by-product is the extention of procedures for audit selection. Actually, New York claimed they are doing the same job as before, but that they think they now have a better selection of returns for review (in terms of revenue maximization), and have been able to eliminate the back-log of review that had accumulated when a manual audit selection process was being used. With a better exchange of information between the state and federal level, more of the work-load may be automated, allowing the audit staff to concentrate upon more rigid enforcement.

One of the discussants made a closing comment which fairly summarized the group attitude toward this problem. The sheer data handling ability of EDP sufficiently justifies its use. Administrators should not feel constrained to use its logical powers to develop complicated norms which, for reasons of policy, may not be sound.

# INTEGRATED ADMINISTRATION OF DIFFERENT TAXES

FREDERICK W. TIERNEY *

I was asked to cover "Integrated Administration of Different Taxes" under three subheadings:

(1) Sales and Income Taxes
(2) Federal and State Income Taxes
(3) One versus Two or One *plus* Two

I do not profess to have the answers, but I hope to stimulate discussion which may result in good practical answers.

I should like to direct your attention to some very practical areas of consideration for the expansion and exploitation of the potential capabilities of electronic data processing in the field of tax administration.

We might begin by raising some questions that to some of us may be academic but which to others in the audience are drawing closer to actuality.

As in all governmental administrative problems, cost and budgetary limitations temper any statement of what "can" be done along these lines. In many instances, unfortunately, what "can" be done falls far short of what "could" be done, whether it be the use of EDP or any other administrative tool that we are discussing. This is true even though the return on an additional investment may be many times the cost. Only when there is a savings is there a high degree of assurance that what "could" be done is translated into what "can" be done (and eventually is done). The old stock market adage that "You have to spend money to make money" is not necessarily followed in Tax Administration.

In all fairness, however, it must be admitted that such budgetary limitations sometimes lead to or at least accelerate the exploration of new avenues to the desired goals. That is, in effect, the governmental equivalent of price competition. This is probably a major factor influencing the increased utilization of electronic data processing in state administration.

The use of a computer for the selection of income tax returns for audit in New York State is an example of this. During the postwar period, budget requests for additional income tax auditor positions had been turned down or severely cut. A survey of the problem area revealed that the audit force could not keep up with the increased volume of returns. This situation forced us to seek the audit selection solution which, in turn, led to the use of a computer a little sooner than would otherwise have occurred. Our first use of a computer was the audit selection program which we ran on another department's machine.

Can EDP be used to integrate the administration of sales and income taxes in those states that have both taxes?

New York State is fundamentally an income tax state. However, because of the permissive nature of our laws, local sales taxes can be imposed and administered as a means of bolstering local revenue needs. For instance, New York City, which is almost a separate entity

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in terms of its relation to the rest of the State, has a City Sales Tax. New York City's revenue requirements cannot be measured by the same yardstick used to measure the financial needs of the rest of the State. This situation has been a perennial bone of contention in our State Legislature.

Several other areas in the State have imposed local sales taxes. Erie County, for instance, the heart of the Buffalo complex, is an example. Several counties have local sales taxes as do a few upstate cities. There is presently some discussion of the advisability of introducing a tri-county sales tax in the Capital District which includes Albany, Schenectady and Troy, each of which is in a separate county.

The matter of integration in the administration of sales and income taxes is not as significant to us as it is in other tax administrative fields. From a detached viewpoint, it does not seem a lucrative field of effort, even if New York had both a uniform state sales tax as well as a statewide income tax.

True integration would require two things of EDP:

1) The identification of the taxpayer in the same way for both income tax reporting and sales tax reporting, and

2) If gross sales must be reportable for a sales tax, then gross sales would be required on the income tax report.

While, in my opinion, full integration making use of EDP is impractical in this dual-tax situation, I believe that partial integration under such conditions might be feasible. The comparison of taxpayer lists on magnetic tape as a means of high-speed detection of non-filers would be both economical and could be done rapidly. There is some question whether EDP would be more economical than manual methods in making a joint field audit of both taxes, although some modification might be possible to adapt electronic processing procedures to the field audit of both taxes.

One way in which EDP would become economically sound would be in the event both matching taxpayer lists and field audit were scheduled as part of and over-all integration of all taxes. The probability is, however, that such an ideal situation is a long way off.

Another question we might consider is, How can EDP be used to integrate the administration of state and federal income taxes? What differences between federal and state taxes can be tolerated without destroying the advantages of integrated administration?

In this area, there already exists a federal-state audit information exchange program. Beyond doubt, EDP can expand and improve on this program. The capabilities of computer programming are most adaptable both to the transmission of audit information and the selective elimination of irrelevant information and irrelevant cases.

The Internal Revenue Service is to be highly commended on its pioneering in the use of magnetic tape EDP. The future holds enormous opportunities for integrated federal-state administration.

Here are a few specific advantages, as we see them, in such a program of integrated administration:

Sharing the work load—Since both federal and state are dealing with the same basic components, the sharing of work in the initial processing of tax returns, sorting, numbering, key punching, calculating tax, selection of returns for audit, refund preparation, bill preparation and adjustment notice prepara-

tion might very well be a shared undertaking with the help of EDP.

In enforcement and field audit operations, the use of electronic data processing equipment and methods could be applied to the performance of a timely comparison and synthesis of field cases and a breakdown of joint cases by geographic location, industry or professional classification.

In many instances, state and federal tax agencies find it necessary to exchange information in such mutally common areas of taxation as income tax, commodities tax, estates, payrolls, etc. Another area where there is obvious advantage to the use of EDP is in the matching of wage statements and information returns such as the federal form 1099.

It is frequently desirable to exchange information on taxpayer rolls to detect non-filers or failures to report income. Here is another example of ways in which EDP can be of tremendous help in providing a fast and economical vehicle for translating and transmitting information.

The second part of the question—" What differences between federal and state taxes can be tolerated without destroying the advantages of integrated administration? "—Suggests these views.

In the first place, it would be desirable to know what information is translated into machine-acceptable form. Since key punching is the most persistent and glaring bottleneck, the great opportunity to economize is lost unless the programs are similar. Further, the identification of taxpayers must be the same. We have found that the social security number is safe as only partial identification. This flaw will be corrected in the future.

There are some legal hurdles that will have to be considered before this happy collaboration of federal and state can be achieved. For instance, a straight percentage of federal tax is unacceptable to most states. The advocacy of a straight percentage of federal income tax as a means of facilitating integration would be a clear case of tail wagging dog. However, a state tax based on federal reportable income is decidedly acceptable. The difference in tax rate is no bar to integration. Likewise, the differences in exemption are far from intolerable, and the differences in treatment of joint returns and income splitting are not objectionable hazards to integration.

One thing that is a detriment to integration is the existence of divergent opinion on what constitutes reportable income when applied to large segments of the taxpaying public. Those differences of opinion would destroy the advantages of integrated tax administration unless they can be resolved.

Another problem that deserves our attention is the integration of state sales and income taxes simultaneously with the previously mentioned integration of federal and state income taxes. If this cannot be achieved, what type of integration should receive priority?

We can see no reason why the existence of one type of integration should preclude the use of the other. If a choice were forced between one or the other, or if it were a matter of which should come first, it would seeem that from a revenue-producing point of view, the federal-state income tax integration would take priority only because it would probably be more lucrative.

Electronic Data Processing will serve as a useful tool to enhance the increased integration of tax administration. In addition to those advantages which result from any and all coordination and

integration, there are two others:

(1) Timeliness and (2) the performance of projects which otherwise could not be attempted. EDP will also enhance the avenues of two-way co-operation. This in itself should increase the enthusiasm for co-operative ventures by both echelons of administration.

Conformity of program and law would enhance the degree of integration possible. The greatest single stumbling block is positive identification of the taxpayer. While this is not as critical in magnetic tape EDP as it is in punched card systems, it is still no small problem.

The advantages which will accrue to the taxpaying public in general stem from the benefit to the group as a whole when taxes are collected from evaders, more efficient government operations in general, and possible convenience to the taxpayer when reporting or audit is limited to one taxing agency. With respect to that portion of the business community using EDP, reporting could be permitted on EDP media.

The co-operating agencies can anticipate reduced costs and increased income to the extent that joint or co-operative programs can be implemented through the use of EDP.

Some of the areas to which integrated EDP is most likely to be applicable are:

Exchange of audit information.

Comparison of taxpayer rolls.

Division of fields of activity by geographic location, industry or profession.

Fuller utilization of wage statements and information returns.

Exchange or co-operative audit selection.

More intensive checking of capital gains transactions.

Exchange of raw statistical data.

## DISCUSSION NOTES

Although the paper was devoted to a broad consideration of integrated administration, the discussion dealt primarily with the integration of state and federal income tax administration. It was emphasized at the outset that there are several areas, currently, to which integrated EDP is most likely to be applicable. These are:

1. Exchange of audit information.
2. Comparison of taxpayer rolls.
3. Division of fields of activity by geographic locations, industry or profession.
4. Fuller utilization of wage statements and information returns.
5. Exchange of co-operative audit selection.
6. Exchange of raw statistical data.

It was further noted that the rapid pace of technological improvements necessitated a continuing program of research and thinking on these points.

Interest centered around the problems of integration posed by the possible lack of compatibility between EDP equipment used by IRS and that which the states might employ. How, it was asked, could a state make use of the federal Master File if its equipment called for magnetic tape with different size and character code specifications? Exchange of information on punched cards, which have fairly standard specifications, was rejected as too costly for the volumes involved. It was thought that various tape-to-tape converters would be a help. The prediction that IRS would prob-

ably acquire such converters (in connection with its desire to allow business reporting on EDP media) was regarded as encouraging. Agreement among EDP equipment manufacturers on specifications was noted as a long-range possibility.

The idea of complete federal-state integration whereby the state takes a simple percentage of the federal tax met with little support. Deductions and exemptions, it was said, were as much policy and morality vehicles locally as nationally. In addition, state revenues would dip and rise with the federal revenues irrespective of local needs. Group members from some states pointed to retroactivity provisions in their constitutions which would make it impossible for their individual legislatures to raise tax rates if the Congress reduced the federal rates late in the taxing year.

After mention was made of the advantages which could be expected, on the basis of New York experience, from integration of reporting forms, the discussion moved to a more far reaching proposal. Could the IRS be called upon to administer the income tax laws of the various states? Among the more significant problems were found jurisdictional complications in trying to enforce liability, and difficulties in allocating "residents" among the various states. The realities of local politics were seen again as mitigating against federal-state co-operation. In reply it was said that the trend is toward co-operation, estate taxation being cited as an example. Others discounted state co-operation on estate tax matters by saying that the states clearly stood to gain by such co-operation. Such evident gains had not been successfully demonstrated in other areas of integration. Canadian experience in integrated administration, it was said, bore out these predictions about the influence of local pressures, despite their somewhat less complex political structure.

The discussion wound up on a general consideration of the place of EDP equipment in tax administration. It was generally conceded that the main saving from computerization is in the co-ordination of paper handling and collections; audit selection and subsequent assessments are by-products of the extension of paper handling techniques. This developed into a discussion of the centralization versus decentralization problems faced by IRS. There is the obvious need of centralization with respect to the Master File and all it implies; but there is an equally strong urge to keep enforcement on a highly decentralized basis. The discussion brought out the criteria to be used in determining the need for EDP equipment:

1. Determine the job to be done.
2. Design the system to do that job.
3. Select the equipment that fits the system.

# STATISTICS, EDP, AND THE TAX ADMINISTRATOR†

STANLEY LEBERGOTT *

ELECTRONIC data processing is an admirable device for doing the unnecessary—by itself or in combination with the impossible. This must surely be one reason why it is the wave of the future. But the high advantage of EDP lies in its capital cost. A pencil sharpener costs so little that it will be installed with no thought to the alternatives. But a sizable machine installation is formidably expensive. This is fortunate, for it raises the possibility that a very rare, and very welcome, event will take place in the organization adopting EDP. The organization will have to think through precisely what its mission is; how its work complements the work of other units; and how EDP fits in when the agency is doing its total set of jobs most efficiently.

We begin by assuming that the decision to install machine equipment in a tax agency is never going to be made because of an interest in the statistics that it can turn out. EDP will be adopted in the hope that it is the most economical way (1) to handle a huge volume of returns with some speed (i.e., billing, refunding, or making deposits to the tax agency account); and (2) to perform a substantial amount of desk audits, including comparison between the related returns of a taxpayer for the present or prior years. We assume that to achieve such administrative purposes, a host of items will be tabulated into the machine records—yielding many more numbers than the data user would need. Moreover it is likely that the administrator will want records kept for all taxpayers—whereas the data user's cup would run over if he had tabulations merely for a sample of taxpayers. Let us assume further that good cooperation will exist between the men who plan the processing procedures and those who speak for the data needs of the policy maker, so that various minor changes and additions in plans will be made to meet the latter's needs.

What prospect, then, does the advent of EDP offer for

(A) upsetting our present system of federal statistical surveys?

(B) providing a surfeit of data for the already hard pressed tax administrator?

## A

When Mallory was asked what drove him on to climb Mount Everest, his answer was reportedly, "Because it is there." If one considers the immense mass of data flowing into the government on tax returns and asks why these data should be used for statistical tabulations, the same answer must be given: because they are there.

We all know that the federal government has a host of other statistical surveys. The Population Census reports on individuals. The far flung Business Cen-

† The opinions expressed are personal and do not necessarily reflect those of the Bureau of the Budget.

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sus tabulates data for enterprises. Other surveys report on capital expenditure, on business income, etc. But wherever the Census enumerator, the Bureau of Labor Statistics agent or the Department of Agriculture field man penetrates, the tax gatherer has been there before him—in person or by paper proxy. Without making a special survey, without hiring a single enumerator, without conducting a statistical inquiry, the federal government each year falls heir to more than a billion numbers on the tax returns. It would be arrant nonsense to run a statistical system that made no significant use of these data, that collected similar sets of numbers all over again.

The signal importance for our statistical system of EDP processing of tax returns lies in one central fact: speed. For it is the absence of such speed that now compels us to conduct a wide variety of statistical surveys. Such information is imbedded in tax sources—but it is available ultimately rather than as soon as required. Let us give one example. (A) Six weeks after the end of 1960 the President sent his annual *Economic Report* to the Congress. Analyzing where the nation stood, it made substantial use of the data on gross national product in 1960—both total product and such vital components as investment, consumer spending, profits. These estimates were put together from an immense variety of small scale current statistical surveys. (B) About 116 weeks later, according to present plans, the Internal Revenue Service will issue *Statistics of Income*. The estimates of gross national product, investment, profits, etc., will then be adjusted to these IRS figures, since they are by definition more comprehensive and reliable than the partial results afforded by the smaller surveys.[1] It will, therefore, not be until sometime in 1963 that we will really know for the first time by how much total production fell from 1959 to 1960; how far profits slid between these years; whether the relationships between investment and profit rates, or between profits and Treasury revenues changed as today we think they did. Meanwhile the forecast of tax revenues for next year must be made from the less satisfactory data on profit-income tax relationships.

Now the expectancy period during which the GNP estimators and tax analysts must make do with less reliable figures has been steadily cut down by IRS. It was only a few years ago that the Budget Bureau proposed a preliminary sample be taken off to provide earlier benchmarks, the Budget providing the necessary funds. IRS has done a handsome job of this, and its *Selected Financial Statistics* now provides data a full year before the regular tabulations runs do so. It is difficult to overpraise the drive and ability that the IRS Statistics Division has shown in carrying through on this. But even that advance still leaves the 116 week delay noted above. Hence it does not render obsolete the array of statistical surveys that do offer timeliness.

But with the vernal prospects offered by EDP we can begin to consider some major changes that will both provide more reliable data for policy agencies—local and federal—and will keep down

[1] Estimates of profits and dividends are directly adjusted to IRS and, in effect, those for entrepreneurial income. Because of the over-all balancing of national product against national income, and the estimating of most GNP components by the margin procedure, it is no overstatement to assert that GNP, national income and their major components are adjusted when necessary to be consistent with IRS totals.

the mounting cost and burden of data collection. Being so urgent, there is every chance that a number of these impovements will be studied; that some of those studied will be considered for adoption; and that, in due time, some of those considered will be adopted.

Before getting down to specific suggestions let me note two comparisons: [2]

| | *Employees Covered by Old-age Insurance* | *Individual Tax Returns Filed* |
|---|---|---|
| | *In Relation to Number of U. S. Income Earners* | |
| 1939 | 58% | 17% |
| 1957 | 86% | 95% |

Our programs for statistical collection have only faintly adjusted to these enormous gains. Begun in that distant era when few wage earners paid any income tax, they have continued on with only modest changes into an era when virtually every income earner files an income tax return, and his employer files at least two more returns for him (i.e., the W-2 and the Social Security tax form 941). In the classic phrase used in every American election since 1800, " it is time for a change."

There are four massive areas of data collection that might be substantially reshaped. These encompass comprehensive data on the number of businesses; on numbers of businesses and persons receiving incomes; measures of the amounts of income; and counts of the population. Such data are collected on a wide scale by the Revenue Service, by the Social Security Administration and the Bureau of the Census. EDP permits us to recognize the advantages of tying together more fully and systematically the statistical work in these areas.

## I. DATA ON BUSINESS

### *Business Censuses*

Let us consider first the major tasks involved in providing counts of the business population. While not the sole function of the Census of Business, that Census provides primarily (1) a listing of numbers of business firms or establishments in each region, metropolitan area, and city, together with (2) some indication of its size, commonly in terms of gross sales. (On some occasions other measures—such as number employed—may be used. The latter is true for the *County Business Pattern* report, which the Old Age and Survivors Insurance Administration issues jointly with the Census Bureau every two years.) The Census tomes are normally issued several years after the fact, while *County Business Patterns* also appears after some delay. (The report for the first quarter of 1956 did not appear until well into 1958.)

Now if we remember that a billion numbers flow into the Revenue Service each year, and take a benevolent view of the potentials of EDP, we must conclude that a great opportunity awaits us. From IRS sources alone, a prompt annual tabulation of the number of businesses, reporting units, employment, payrolls and gross sales might be made with no necessity for field surveys or subsidiary tabulations. That such a goal may be feasible is suggested by two facts. (1) The *County Business Pattern* reports today are largely mere tabulations of the form 941's filed with IRS by business. (2) Some years back the Budget Bureau suggested that the Census of Business might use IRS returns

[2] Basic data from Bureau of the Census, *Historical Statistics of the U. S.*, II, pp. 194, 714.

instead of field enumeration. This was in fact done for firms without employees, beginning with the Census for 1954. And the necessary combination of Census and IRS work proved to be most effective—indeed much more harmonious than relations between sister statistical agencies sometimes are!—and marked savings in costs were achieved. With EDP one can imagine that in future Census years, the required tabulations both for the Census and for *Statistics of Income* for Corporations, Partnerships and Sole Proprietorships will be done with a unified set of machine programs.[3]

Now proposals to extend the industrial scope of the Censuses have been made regularly. For the economic meaning of the universe of business now covered by the Census Bureau is somewhat limited: mining is included but transportation is not, retail trade is in but real estate is not, shoe repair stores and advertising services are in but construction is not. It would be hard to argue that the universe of "in-scope" business covered by these Censuses is particularly meaningful. This difficulty is certainly one of the reasons why pressure to increase the number of Censuses continues, and why demands for the *Business Pattern* report every year arise.

EDP offers us an out from the costly dilemma—of extending the Censuses largely *or* continuing to lack a basic set of measures of interest to local agencies and groups, to marketing organizations. With EDP we could (1) tabulate the number of businesses annually (rather than biennially). And we could (2) measure the number of business enterprises instead of merely the number of employing units in each locality. Surely, for example, the present biennial measure of the number of retail units in each county, omitting as it does all firms without employees, omits well over half the total. And, finally, (3) reporting of number of firms by gross sales size would, for many lines of industry, be far more informative than a classification by the number of employees. In trade and service, for example, most of the labor is not provided by employees, but by the self-employed. In other lines, such as utilities, petroleum refining, etc., the extent of mechanization is so great that the input of labor only faintly indicates the over-all scope of the business. The IRS data on sales can provide such broader classificatory data.

Now we all know that the Business Censuses provide us with more than simple statistics on the number of businesses and their size. They offer a great volume of information that apparently fascinates statisticians and marketing men—but would not remotely be reported on any IRS return. Does this imply that IRS can, or should, provide details on manufacturing products, employment by occupation group, etc.? Hardly. Even now such information is not collected from all firms but only from a sample, and for many classes of information that sample includes only from the larger or multi-establishment companies. Such statistical operations under statistical agencies auspices would have to continue, and in many fields. The particular contribution that IRS could make would be to provide for all firms the basic information which now generates the bulk of survey costs.

[3] Additional Census work to get items not on the tax returns—e.g., line of merchandise sales, product output—would clearly be needed. We consider only items in which Census interests and *Statistics of Income* tabulations overlap significantly, and peak loads in one program might be distributed differently from that in the other. If so, economies in level of operation for both agencies would be envisaged.

As for all good things a price must be paid. To achieve this reduction in government expenditure and respondent burden, the major cost would be one of rethinking and readjusting. This is an enormous cost, of course. But it is no greater than that involved in the shift to EDP, and I shall merely mention it. A second cost is created by the need to make a significant improvement in the information that businesses report to IRS on the industry in which they are engaged. In the last few years, as you know, the tax forms have already been changed in an attempt to improve these data. One might hope for a significant speed-up on the already developing IRS program on this, so that the IRS will not classify a firm in one industry, the SEC in another, while the Census may classify it in a third industry. Here the statistical agencies could perform a useful task by helping to put together such information, which, when poured into the EDP records, will give us more accurate final results.

*Mergers, changes*—Another set of counts could increasingly be taken over by IRS once the EDP program is put into force. I refer to the figures on changes in corporate organization via merger and purchase. The corporate tax form already provides basic information on the larger corporate entity—specifying the name of the corporation, etc., that owns more than half of the voting stock of the filer. I assume that optimum use of EDP for tax work *per se* will involve comparisons between present and prior year filing. Hence the system must be programmed to locate the comparable tax returns for last year, to test changes in asset structure (how much revaluation?), changes in sales, profit rates, etc.[4] But given such data in EDP records for tax purposes, it would be possible to measure the number of mergers and business combinations. (For Treasury tax analysis there might well be an additional interest in seeing to what extent shifts in corporate organization, and shifts between legal forms were taking place; and to have some factual basis for knowing whether changes in the tax law seemed to be speeding or halting certain types of shifts. Surely, for example, the provisions for tax loss carry over had some influence on the extent to which companies were bought, merged.) The Census Bureau, as the FTC, is already making such comparisons in a variety of tabulation programs. Such work could be done more accurately, more reliably, and more meaningfully if the full potentialities of IRS reports were realized.

*Business births, deaths*—The Department of Commerce regularly estimates for each industry the number of new businesses organized, and the number discontinuing operations. Measures of business births and deaths are hopefully sought as an indicator of short term economic changes. But the present figures are issued too late to be of any value for this purpose. EDP would make possible prompt tabulations on business births—which are compiled from applications to IRS for employer identification numbers. More important, perhaps, the specialist in economic indicators have demonstrated that the amount of business liabilities offers an ever better guide to the dubious future than does the mere number of failures. I assume

[4] The possibility of showing a distribution of changes in income items, investment, portfolio balance from one year to the next in relationship to initial year balance sheet measures is an enticing possibility—but one which would involve more rather than less cost.

that such superiority arises because the liability total serves as a crude measure of business size: when the larger firms begin to go under, the economic storm is growing more serious. If this analysis is correct, then a tabulation of discontinuances by size would be serviceable. The volume of the firm's taxable payroll at the time of its failure or discontinuance provides such a measure.[5]

*Population Census*

It is well known that *Statistics of Income* has nothing to do with the Census of Population. But EDP may well upset this truism, along with many others. To ease gently into the problem let us consider first the growing pressures to take a Census of Population every five years. Proponents have argued that this mid-decade measure is necessary to distribute Federal and state funds equitably where a formula provides that these be passed out in proportion to population. This argument has been seconded by those who favor giving business and marketing organizations up-to-date (and minimum cost) measures of population distribution—plus, perhaps, other simple indicators of changing markets. The cost? A relatively modest estimate is a mere $75 million.

What could we do with $75 million spent instead for EDP tabulations from IRS? Clearly an enormous amount, if only the relevant data were available. I believe that a serious first look suggests enough potential to deserve investigation. The time needed to get such a quinquennial Census off the ground may well be no greater than the time required to get IRS-EDP operations into working order. What about the data?

We all know that many millions of persons now file tax returns. It is no less true that virtually the entire population is reported on tax returns *as exemptions*. In 1958, about 161 million exemptions were taken on the personal income tax returns.[6] But the population total was 173 million—or a mere eight per cent greater. It is clear that despite the practical exemption from filing for many low-income families, the growth of the withholding system has made many of them file.[7] (The biggest single group excluded would appear to be low income farmers.[8])

Now suppose we consider the IRS returns not as offering a direct estimate of the population in the mid-Census period—but rather as constituting an enormous sample of the population. It is at once clear that EDP offers an extraordinary opportunity for estimating population change over the period if only we have the wit to use it. It is well known that an estimate of change can be made with a smaller sample than that required to make a direct estimate. A sample that is well over 90 per cent of the total is clearly sufficient to estimate, say, the change from 1960 to 1965 in the population of every state, every

[5] A more precise measure would be payroll in the penultimate—even antepenultimate period. To achieve this would probably demand a fairly costly search procedure, however.

[6] *Statistics of Income* shows 168 million. We deduct seven million for the age and blindness exemptions; the total for these groups in 1956 (the last available year) ran to about 6.3 million.

[7] In 1958 there were 3,950,000 returns with adjusted gross under $600. Since 3,369,276 of these had salaries and wages, the bulk were not entrepreneurial returns with losses, but rather wage earners with incomes below the exemption limit.

[8] The *1950 Census of Population*, Vol. II, p. 129, gives a distribution of experienced male labor force by income level. About one-fourth of that group were farmers. Given the distribution of family size by occupation, we conclude that the proportion of omitted population in such families was about the same or possibly slightly greater.

metropolitan area and quite possibly every other unit for which such data would be needed. And, of course, the accuracy standard against which we test this procedure must be what is afforded by ordinary Population Census procedures that rely on a mass of temporary enumerators, themselves not peerless and without fault in counting the population; nor even random in their biases.

To this point we have been considering IRS as a source for a simple population count. But suppose that somewhat more data were required? The tax return, it will be remembered, already reports income, occupation, employer's name(s), address, names of family members—or a very great proportion of the items covered on the Census. If these items were pulled out and put on a separate piece of paper with different headings, the form would be remarkably close to the self-enumeration schedule distributed throughout the land in the Census of 1960. While much better than that form in some respects (its income detail is better and at least as reliable; its information on work experience—via the W-2s attached—is in many respects better) it fails to provide other data. But since the quinquennial Census is justified almost solely in terms of getting a simple population count, this fact constitutes no problem here. It is a problem for the person who conceives of going even further, to use the source to transform the regular decennial Census. It may not be out of the question to think that the next decennial Census will rest primarily on a tabulation of IRS tax forms, after some changes in these forms, plus a small scale statistical survey to provide complicated detailed information that even now is not collected from everyone in the Census but only from a sample. There is little question that a variety of problems would arise in trying to use the Revenue Service materials as a starting point for quinquennial enumerations, and particularly if used to assist the Decennial Census.[9] But there is no question that with, say, $120 million at risk for the next decennial Census, plus $75 million for the proposed quinquennial Census, the problem of using material in the EDP files must be seriously explored. The possibility of saving $25 million—$50 million?—over a decade deserves the most serious investigation in these days of multi-billion dollar budgets. The possibility of deriving data of higher quality offers a complementary incentive.[10]

## B

EDP has another virtue. It will add to the flood of figures that already inundates the harassed tax administrator. This would seem to be a dubious contribution. And so it may prove to be. But we have a right to assume that intelligent programming will skim off for the administrator only the small set of figures that bears precisely on his work, and bears more precisely than does the multitude of numbers available hitherto.

9 Among others: an exemption listing such as that on the 1040A would be required on the 1040, plus a column for age. We have no systematic test of the adequacy of occupation reports on the 1040. Could data on color and nativity be adequate on a sample basis? How could exempt income families be reported—by requiring a pro forma tax filing, by some other economical procedure?

10 By definition the Population Census cannot hope to derive income data superior in quality to IRS. The W-2 provides employer name and identification number—permitting a more accurate industry code than the housewife usually gives. Conceivably the W-2, in Census years, might include an occupation title as well.

(If we are not prepared to assume intelligent programming, EDP as a whole becomes a hopeless business.) What that choice of figures should look like turns on a judgment as to what the main line of tax administration really is.

We assume that the central task of the tax administrator is to maximize voluntary compliance with the tax laws over the long run. His tools for doing so range from persuasive discussion with legislators who are working out new tax laws, and from the promulgation of equitable rules and decisions, to programs for educating high school students in tax arithmetic. But probably the dominant, central method available to him will be the use of his enforcement staff for making desk audits and field investigations. If he puts that entire force into one area, one tax, he can maximize the return from that source—at the risk of letting compliance slide in fields with much larger dollar aggregates. He therefore must seek some level of across the board compliance, some maximizing of immediate dollar returns from agents' salaries, and some action in areas where complaints, intuition, or specific situations urge special emphasis. EDP offers him some guide to this labyrinth of choice. He can make an intelligent disposition of forces in one pattern only if he knows what revenue is foregone by this choice. EDP makes it possible for him to have sufficiently prompt, sufficiently detailed measures of

(a) what the distribution of the tax potential is—by tax and by geographic area;

(b) how the distribution of returns filed, and tax collected, compares with that potential.

It is standard procedure in many organizations to measure the potential against which their effort is to be assessed. A soap company may test its sales effort in an area only after some judgment as to how much soap could be sold in that area. More complex organizations require a similar reference frame. The Strategic Air Command, for example, measures performance of the various SAC bases against specific numbers indicative of the job to be done, the instant capability required. The tax administrator falls somewhere between these two. His considerable advantage, however, is that potential is much more readily measured for his work. Let us consider some specific aspects.

*Number filing*—Any significant volume of nonfiling has a corrosive effect on voluntary tax compliance as well as on revenue. It is not surprising, therefore, that many efforts have been made to test the amount of nonfiling. Perhaps the most obvious and most expensive method of doing so is to send trained revenue agents out to canvass a neighborhood, a list of persons engaged in an occupation or line of business. There are few categories of personnel more difficult to recruit, to keep on in the face of the many alternative (and more lucrative) opportunities. Even were they particularly good amateur Census agents —which requires demonstration— more revenue could be brought in were they to stick to the main work of auditing while other techniques were used to measure nonfiling. And, even more decisive, the very decision to send them out implies ignorance as to where any significant nonfiling exists—so that the use of their time even for such work may be inefficiently deployed.

A more direct measure of non-filing may be sought if we think in terms of statistics sufficient for administrative decision. Such data, for business enter-

prise, would be provided by a comparison between Census tabulations and IRS filing tabulations. At quinquennial intervals the Census of Business already provides us with a count of the number of businesses, by type and size, for the major sections of the nation and the individual states. It is, of course, well known that no Census information has been or will be disclosed to the Revenue Service. But the published volumes of the Census are available to the tax administrator, as to anyone else. A comparison by revenue district of the number filing with the agency and the number reported in the Census count gives the basis for measuring the variation in percentage filing among the IRS districts. Such information should be highly informative for studying tax potential.[11]

Such comparisons can be made now. But to tell the administrator what the ratios were three years back is hardly likely to elevate his spirits or command his interest. EDP makes possible a tabulation soon enough to have some bearing on current choice. Precise comparability between the sources is likewise necessary. The procedure outlined above (whereby Census begins from an IRS return file) provides this comparability.[12]

*Income potential*—There are more important factors than outright nonfiling, however, so far as the major taxes are concerned. One may doubt, for example, whether as many as four small corporations in 100 fail to file income tax returns with the Internal Revenue Service. But more than 40 in 100 understated their net income according to the IRS Audit Control Program for 1949, the most recent year available. And the amount by which their net income was understated came to about 30 per cent.[13]

The administrator's problem with respect to income potential falls into two parts: (1) getting the facts; (2) doing something about them. Are taxpayers in one industry reporting only 60 per cent of their net income, whereas most other industries report over 80 per cent? Are taxpayers in one area of the country reporting far below the national average? It is clear, for example, that the answers are not given by figures on yield per audit man year. One district office may properly show a much smaller return per investigation than most others: —a low income farm area should have a lower potential than a high income urban area. He, therefore, requires a measure of tax potential, e.g., by type of income by administrative area. We lack such data now, and while approximations may be feasible at present they will be much more practicable under EDP.

[11] It is obvious, but perhaps worth iteration, that the variation in percentages would indicate differences worth further analysis by the tax agency, to see to what extent these filing differences reflected factors other than intent not to file. They are a starting point for the administrator's study, not a basis for immediate sharp interoffice memoranda or reallocation of agents.

[12] We assume that the procedure of choice would be for Census to tabulate for firms in the IRS file, to make a field canvass by area sampling that would permit an independent estimate of the total firms in business. A disproportionate expansion of that sample would permit estimates in greater area detail or with greater precision—the cost of which to the government as a whole would be less than the use of revenue agents to provide such detail, particularly since it would not necessarily be consistent with the broader, more comprehensive measure.

[13] Cf. the data in Marius Farioletti, "Some Income Adjustment Results from the 1949 Audit Control Program," in Conference on Research in Income and Wealth, *An Appraisal of the 1950 Census Income Data* (1958), Tables 10. 11.

We take some examples with respect to personal income. (1) A tabulation of W-2s issued could give us wages paid to each geographic area, and a tabulation of wage totals as shown on the personal income tax returns would give the wages declared. From these a measure of potential by area could be readily computed. (For this purpose no collation of individual returns is required nor particularly useful. We are dealing with over-all control data usable for over-all administrative evaluation.) (2) A similar comparison could be made between dividends paid and reported dividends received, again by area. (3) The gross income from self-employment in individual lines of retail trade and service could be assessed by comparisons of income reported on the tax filings with the aggregate retail sales reported by the Census of Business.

To provide realistic measures of potential across the board, however, new data would have to be developed by the tax agency itself. Existing measures indicate that with respect to (1) above, the percentage of wages and salaries reported is very great, while the dollar total of omission for (2), dividends, is small. A major problem relates to business and professional income.[14] For this purpose the available data on results of audit work are insufficient, since revenue agents sensibly concentrate on the returns that promise a maximum result rather than a representative sample. Even a full scale audit control program would not suffice to measure potential if portions of it related to different years: to learn that 20 per cent of tax A was not paid in 1961, and 25 per cent of tax B was not paid in 1963 tells us very little. For there may be enough variation in agent performance from year to year, and/or taxpayer reporting, so that if only we picked the same year for each tax, we would find that there was no real difference, or even the reverse pattern.[15] (By extension the longer the gap between periods, the better the chance that still further confusion will be introduced by variations in the business cycle, etc.)

The urgency of an audit control program for the improvement of our current statistics on national product and related statistics has been urged by the Department of Commerce.[16] This recommendation reflects the fact that the most astute manipulation of existing data still does not give a sufficient total for income, and a significant adjustment must therefore be made to customary statistical data to compensate. The tax administrator requires similar information. He must have it both more up-to-date and more precise than that needed by the statistician, so that for the first time EDP offers the speed potential and flexibility for providing such tabulations. Greater precision may flow from a fuller consideration of audit procedure.[17]

[14] Estimates of tax return figures as a percentage of the Commerce Department over-all income estimates appear in Selma Goldsmith, "The Relation of Census Income Distribution Statistics to Other Income Data" in Conference on Research and Income and Wealth, *ibid.*, p. 80.

[15] The problem of variation through time is discussed with respect to one industry in the writer's "Entrepreneurial Income," in Conference on Research in Income and Wealth, *A Critique of the United States Income and Product Accounts* (1958), pp. 482-84.

[16] Office of Business Economics, *U. S. Income and Output* (1958), p. 105.

[17] Computation of data from Farioletti, *op. cit.*, shows that the random audit added about 30 per cent to net income of small corporations—but only 20 per cent to noncorporate business. A closer look at the noncorporate detail shows, e.g., a 36.7 per cent increase for hotels, but only an 8.9 per cent rise for

It would be a bold man who concluded that once armed with such knowledge, the administrator of any tax agency could damn the torpedoes and order full speed ahead. We assert merely that he *must* have a knowledge of potential to know where his agency is and where it is headed. One might even offer the faint hope that with such factual information, he will now and then be in a better position to meet pressures to go this way or that. The limitations given him by the tradition of his organization, by outside pressures, are not enormously different from those that are set for the design of public multi-purpose water projects, or from the capacity limitations set upon a multi-product firm. The use of EDP to solve with some speed linear programming problems in these areas gives some hope of parallel application in tax administration.[18]

I should be less than candid if I gave the impression that all these good things must wait for the full flowering of electronic data processing in the revenue service. They do not. Some are quite speculative suggestions that can be assessed without referring to EDP—although their full gains would be reaped only under such a system. Other suggestions could be initiated once there were agreement on their advantage for policy decision. It may have been useful to speculate on the continuum of advance we seek, in order to stimulate such study and present action.

barber and beauty shops; a 21.0 per cent for real estate, but only 7.1 per cent for insurance agents. We find that these did not represent differences in taxpayer performance—but reflected instead variations in the volume and type of records available for the agent to make a judgment. If we assume that within the broad group of services, the same ratio maintained as for hotels; within finance, that for real estate; and so on for other major groups, we would estimate a further gain of 10 per cent. The implied total of 30 per cent increase for noncorporate business is then about the same as that for small corporations.

18 The efflorescence of work in linear programing in recent years, and such specific studies as those by Cooper and Charnes on petroleum production, Eckstein on water policy, Danzig on air force readiness demonstrates that systematic programs can be developed for the most unlikely programs.

## DISCUSSION NOTES

Comments here fell broadly into two categories:

1. The utility of audit control, and
2. The problems of data recording created by the incorporation of broad statistical aims.

The proponents of random sample auditing again elaborated on the way EDP could help. The joint tabulation of tax and other statistical data could be used to develop geographic and income brackets distributions covering the incidence of nonfiling, nonreporting of income and excessive exemptions and deductions. With this information available the administrator is better able to decide whether, in a given area, to aim his enforcement activities at broader compliance with the law or to stress individual assessment yield. He would have a better idea of the financial impact of his choice and could test that idea against actual results soon after the step was taken. Criticism was again directed against the corrosive effect of " average " deduction statistics on the tax base. Many criticized the policy of introduc-

ing equity into the tax law via " honesty " deductions because it put a premium on " chiseling " and otherwise left equity decisions in the hands of the administrator.

Next, the discussion developed the idea that there was a wealth of data available on forms and papers filed with the IRS. The adoption of EDP methods held promise of greater returns in such areas as:

1. Population statistics.
2. Business census and statistics.
3. Gross national product and national income figures.
4. Better exchanges of data between state and federal levels of governmental units.

The problem of what information was to be recorded was seen as a question of weighing such factors as:

1. The need for simplicity in volume data handling operations,
2. The necessity of broader planning if ancillary statistical benefits are to accrue, and
3. Computer speed and hardware limitations.

Finally, some mention was made of the possibility of making IRS data, edited to preserve anonymity, available to industry and research organizations. The group was informed that legislation had been introduced in the Congress which would permit IRS to perform some limited service functions in this area.

In shifting to a consideration of the statistical possibilities offered by the Master File and EDP techniques, there was a strong suggestion that " research programs " be included within the " operating programs " to be developed. Since many of the research activities would be working with statistically sound samples rather than the whole universe, apparently time allocations would be no problem. At best, only 10-15 per cent of the computer time would be necessary to work on the statistical considerations raised in the paper. Further, with legislation pending to allow an exchange of data between the government and private enterprise, many of the statistical manipulations envisioned by the paper could be handled by research teams in private business and universities. Apparently the only major unresolved question centered around the appropriate nature of the input into the Master File: Will it contain the kinds of data needed for the statistical work to be done? The question was not resolved.

# TAX AUDITS—THE SPECIAL PURPOSE AUDITOR MEETS EDP

A. B. TOAN, JR.*

HOW the tax auditor (and others like him) reacts in the face of EDP can have a lot more to do with the future of business electronics than you might at first expect. In part, this can come about because the tax auditor shares certain problems with all auditors. It can also come about, however, because the aims and the techniques of EDP men can easily run counter to the special needs and wants of tax and other " special purpose auditors "—unless steps are taken to make sure this is not the case.

An understanding of the nature of the potential problems and an exploration of potential solutions are important. It is my present purpose to explore these topics, discussing the future as it appears to me.

## *The Special Purpose Auditor*

The tax auditor, I think we can agree, is the government official who has been assigned the responsibility for determining that the financial data (net income, sales, payroll) which form the basis for the self-assessment of taxes have been properly established and reported. As such, he falls into that category of auditors which, for purposes of this paper, I should like to describe as " special purpose." This characteristic obviously has some critical importance in my speculation about the problem. I should like to indicate why this seems to be so.

Auditors can quite easily be made to fall into two broad categories—general purpose and special purpose—with quite different objectives and working habits. Military contract auditors seem to fall into either or both classes, depending upon the nature of their relationship with a particular contractor.

In one category is the general purpose auditor—the independent CPA (and often the internal auditor as well). The CPA typically is engaged to make an examination of the financial statements of the company as an entity and to render his opinion on their fairness to stockholders and others. This broad orientation is directly reflected in his approach. He is concerned with the company as a whole; he relies extensively on the company's own system of internal control, reviewing, testing and recommending improvements in procedural and managerial controls; even when he turns his attention to individual accounts he is constantly plumbing the system of control and making extensive use of information learned in one part of his work to cross check against related information obtained in another; he typically has free " access " to the plans, policies and decisions of management; he is often on the company's premises as events take place which are difficult to reconstruct and thus can test procedures and check situations (e.g., inventories) as

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the events occur. His approaches, in short, are varied and broad, looking at control and the company as a whole.

Special purpose auditors, the second category, normally have different characteristics and different needs. Tax and other regulatory auditors, I believe, would fall into this category. They usually have most of these characteristics in common:

1. They have a limited purpose—to determine compliance with some income tax, payroll tax, sales tax, FTC, wages and hours or other type of law or regulation.
2. They have a limited interest. Their audit is concerned with the procedures, documents, reports, pertaining to a limited area.
3. They will usually accept only certain kinds of evidence of compliance. They place great emphasis on the written, often the legally admissible document. There is relatively little reliance on over-all corporate procedures and controls and often even of procedures in the particular area of their interest.
4. They have the legal authority to require what they feel they need, and often what they want as well.

That there is a difference is, I believe, quite clear. Perhaps it can be stated in this way. The general purpose auditor —because of his aims and his methods— is procedure or control oriented; the special purpose auditor—because of his present aims and methods—is essentially document oriented.

### *The Question*

The question, or the potential point of conflict under EDP, can now be established. If, as now seems probable (other legal requirements permitting), documentation may be reduced or in its present form often disappear, can the special purpose auditor accomplish his aims? Will he shift his methods or his concepts of evidence to the extent necessary or will he insist upon what may well be his legal rights? Will he be able to do what most general purpose auditors now believe they can learn to do—rely much more heavily than heretofore on systems which control the origination and flow of data and much less heavily on documentary evidence? Or will he feel he has to insist upon the document? Will he " to fill his needs " thus materially affect the direction and the growth of EDP?

### *Points of View*

This paper proceeds from the assumption that there is little point in talking about answers to these questions in terms of the problems which exist today. Most of these problems, because EDP is in its infancy, are not really very difficult; in fact, so far as I know all have been rather easily solved. Thus, to have value, the ideas expressed must be predictive and speculative—aimed at a target lying some five or ten years ahead.

This paper also reflects my belief that the initial incidence of problems relating to electronic tax records and tax audits will fall almost entirely in large- and medium-sized companies which have their own EDP equipment. The problems will be found and have to be worked out in these companies (1) because generally speaking, it is the larger companies that are further advanced in their electronic work and (2) because alternative methods of audit, which might be considered where advanced EDP methods are employed, may be more difficult to find and to use because of the companies' size. Similar problems will I believe, be encountered only occasionally in smaller business at the outset, al-

though probably increasingly as the years go by. However, I would suspect that by that time both policies and practices would, for the most part, have been pretty well worked out. The same situation should also prevail with respect to the independent EDP centers serving many companies. The problems should be less acute, at least for some years to come, because generally the most advanced and far-reaching techniques will be employed only when companies have their own equipment.

Thus, the comments are predictive and speculative with a large/medium-sized, own-equipment point of view.

*Assumptions About the Future of EDP*

Before attempting to deal directly with the problems of special purpose audits under EDP, I must also state some assumptions, directions and trends (representing my beliefs) about the future of EDP. I have assumed the following on the basis of looking ahead some for the next decade:

1. In many companies most of the clerical procedures of major concern to tax and other regulatory authorities will be handled on EDP equipment. This is not to say that all the major clerical work of the company will be performed on EDP equipment—since many (production scheduling and control procedures, for example) may still not. It does look, however, as if those of greatest interest to tax and other authorities may well be:

   Almost surely on EDP—
   - payroll
   - billing and sales analysis
   - inventories
   - materials and supplies
   - accounts payable
   - profit and loss analyses and costs

   Less surely, but probably on EDP—
   - accounts receivable
   - fixed assets and reserves
   - general ledger

2. Much of the information which is now originated on, recorded on, and/or processed into tangible, visible documents may, in the future, be handled in intangible, invisible form.

   One major change, for example, may drastically alter the manner in which data are originated. Externally originated data—principally vendors' invoices and purchase orders—will probably be largely the same. So too would some internally originated documents and reports, e.g., expense accounts, capital authorizations, checks. But much of the internally generated data would be different. Where we are now used to seeing data recorded in a hand-written form, we may quite easily find an original recording in electronic or some other machine processable form—with no accompanying document. It is quite easy to believe, for example, that recordings on tape from special slugs, from key-driven devices, or from recording instruments which are part of an industrial control system, may at some time in the future be the basis for originating a major portion of the information to be processed. In short, the visible, signed, authorized reports of hours, material issues, shipments, etc., on which both the company and the special purpose auditor now rely may on many occasions vanish from the scene.

   A second change—the location of data—will occur with improvements in communications technology. As communications devices become faster and cheaper, increasingly greater amounts of all kinds of corporate data will be originated at many outlying points, be transmitted to a central point by wire or microwave, be processed electronically, with the information being returned (in summary, in detail, or perhaps not at all) to its

point of origin. Quite probably, the originating documents, if they exist, will increasingly be retained at the outlying points.

Third, output documents may be limited if we look for them in " hard copy " form; electronic copies will be their substitute. The more one works with EDP, for example, the more one sees that most of the records which a company keeps in visibile, paper form need not actually be kept in that manner for the proper conduct of the business. Retention of records in electronic form would serve just as well, with " hard copy " being prepared only on request or when the machine itself determined, by applying certain criteria, that the information it contained was wrong. To cite a simple illustration, the file of sales invoices could easily, at some time in the future, serve its purpose if retained only in electronic form; paper copies of invoices would be unnecessary for internal use. It is quite probable, too, when " hard copy " was required that even it might appear in rather transient form, if it were, for example, merely displayed upon a screen or tube for the period of time in which it was in use.

Finally, it seems probable that in many cases the transaction registers, the journals and the lists of items which are characteristic of most of our present machine processes, may diminish in number and in size as machine systems are developed which enable businesses to post directly to accounts, without first sorting and summarizing the individual items involved. Transaction lists may exist, probably in electronic form, but they may more frequently not be organized by account number, by branch or by any of the other ways in which we are accustomed to find them.

3. Corporations will develop new internal control systems, in order to protect the integrity and accuracy of their records, which do not rely upon visible, tangible documents. They will, instead, be directed toward the protection and the control of what might be described as a " stream of data in electronic form." This new system of internal control will prove adequate for corporate officials and for the needs of independent certified public accountants as well.

These are rather basic and far-reaching assumptions. Perhaps it is wrong to believe that they will be accomplished to a marked degree in the decade ahead. They do almost certainly, however, indicate the direction which (the law willing) is going to be taken and the problems which are going to have to be solved. Thus, assuming too great a speed of accomplishment really has only the disadvantage of advancing the date at which solutions will have to be found.

### *The Essential Problem and Its Solution*

The essential problem then, to restate what I have tried to say, is for the tax auditor and others like him to find some way which will enable him to carry out his limited purpose audit efficiently without the present extensive reliance on documents, lists, registers and the present-day " hard copy " forms.

The essential solution which would best enable EDP to grow in a natural, " uninhibited " manner would, it seems to me, be:

1. For special purpose auditors, by consolidation, mutual reliance and other means, to make their purpose broad enough so they can audit as general purpose auditors would.
2. For them also to learn how effectively to audit what can be called the " stream of data in electronic form "

—through training, through selection and experimentation with the audit of records in electronic form.

I should like to use the remainder of this paper to discuss what I believe can be done.

BROADENING SPECIAL PURPOSE AUDITS

Three methods seem most promising for permitting the special purpose audit to be broadened or incorporated into a general purpose audit. They are:

1. To consolidate the special purpose audits of many or all tax authorities and possibly other special examiners as well.
2. To make the provisions of tax laws as similar as possible, so that individual tax auditors can rely even more heavily on the work done by other tax auditors than is the case at present.
3. To continue or perhaps to increase the reliance placed on independent CPAs to provide special information found necessary during an audit.

A discussion of each of these approaches follows:

*Consolidating Special Purpose Audits*

Consolidating the audits of many if not all tax authorities and other regulatory examiners to make their purpose more broad is one approach—substituting, in other words, an audit on behalf of all states or on behalf of the federal government and states, or on behalf of all tax and regulatory authorities for the highly specialized examinations now conducted by each. This approach could, in short order, turn the limited audit into one whose purpose was broad. It would be broad enough, in fact, to justify an increase in time which would enable the tax auditors to become acquainted with the company's procedures as a whole. This would enable them, in turn, to place a far greater degree of reliance on procedures and controls and thereby to limit their reliance on the individual document. It would enable them also to accept these documents and the evidences of their creditability in electronic form. It would enable them to use their knowledge of the operations as a whole to supplement or substitute for their concern with the individual item. Finally it would enable them to do more "current auditing"—auditing when the transactions are initially being run and documents are initially being created—which in many cases will be the best time of all.

Only rarely will these things be possible unless purpose is broadened through the consolidation of audits.

*Making Provisions of Tax Laws the Same*

Extending the present trend toward conforming the provisions of federal and state laws or of state laws alone so that even if audits are not consolidated, at least each can start where the "most interested" leaves off, is the second approach. If the "most interested" (which might be auditors representing one state or a group of states) can spend the time to audit in the manner described in the section above, he can reduce the reliance on the individual document to the extent that is necessary for the special purposes of the remaining auditors. These requirements of the remaining auditors then could be sharply reduced, perhaps to the checking of allocations, if the "most interested" could give the others reasonable assurance that results would be fair and correct.

Clearly, if laws do not conform within reasonably narrow limits, ideas of this

kind would work only with extreme difficulty, if at all.

### *Reliance on Independent CPAs for Assistance in Connection with the Tax Audit*

Reliance on independent CPAs to provide special information found necessary during the tax audit—on current or expanded lines—is the third approach.

At present it is not uncommon for independent CPAs, at their client's request, to cooperate with tax auditors. This cooperation, while it varies in scope and degree, usually is concerned (1) with providing information about accounting policies and (2) with the preparation of financial analyses of various types. The CPA obviously does not make the audit for the tax examiner; he does, instead, in essence make his knowledge of the company's records and procedures available in the form of factual analyses of recorded data.

It is almost certain that this coopera- will continue with EDP; it is logical, in fact, to assume that the area and degree of cooperation might expand—with, of course, the taxpayer's knowledge and consent—because of the new data processing methods.

The " general purpose " strengths of the independent CPA's examination would thus be used to assist those of the special purpose auditor in his work.

### *General Comments*

It is clear that each of these approaches will require changes in the tax examiner's conduct of his work. None of the suggested approaches is technically unattainable or even particularly difficult from that point of view. The first two, however, have important, practical, difficult, political, human aspects to them which cannot be ignored. They may also involve matters of tax policy as well —but that is the province of others, not of me.

The pessimist would say that I am dreaming; the optimist would say that to get ready is what the next ten years are for. What the realist would, or should, say is still to be determined.

But, to repeat what I have already said—if the special purpose auditor wishes to stick by his established, usually legal rights, he can force business to produce, process and retain almost all of the present documents, lists and forms even where there is no need to retain these for other purposes. This almost certainly will place sharp (and otherwise unnecessary) restrictions on the progress of business EDP. My feeling is that special, like general purpose auditors, will not wish this to be the case. He thus will find some acceptable way (1) to broaden his approach and (2) to accomplish his second task—learning to audit EDP.

## LEARNING TO AUDIT EDP

If the tax auditor of the future decides to enforce his right to documents, lists, forms, etc., he may—much as he does now—ignore the existence of tabulating equipment as well as EDP. If, however, he chooses to follow the other route and conduct on his own or on some joint behalf an audit of advanced EDP, he has a great deal to learn—just as does the CPA.

There are certain things which the tax auditor—or perhaps a rather special group of them—can profitably do.

1. They can select, or if necessary hire, an adequate number of people who can learn to understand the concepts and principles and techniques of EDP

and to apply them in their audit work.

2. They can acquaint these men with EDP techniques from both the procedural and the machine point of view—so that they will understand not only the processing of information within the EDP machine itself but techniques of data origination, data transmission, data control and data reporting as well. To the extent practical, they can provide this knowledge from the "company point of view," so they can begin to find out whether and how data can be controlled to produce honest and accurate results.
3. They can set out deliberately to work with EDP in auditing real or simulated situations. They can, for example,
   a. Avoid "leap-frogging" or "auditing around" EDP systems, resisting the temptation of assuming that, if the input to the system is adequately reviewed and controlled and the output can be checked back to source documents, then what went on within the machine system can be safely ignored.
   b. See what would happen if input data were originated in nonvisible form and if final documents were not normally printed out but rather were retained in some type of electronic form. Try to develop some guidelines which business can use as to documents which it will not be possible to eliminate.
   c. Change the timing of audits to see what can be accomplished by current or interim audits rather than by examinations conducted many months after the fact.
   d. Develop methods for testing the accuracy and reliability of EDP systems by creating test problems with known answers which can be passed through EDP systems to check their performance.
   e. Develop techniques by which the EDP system can be used to audit itself—first to test its own arithmetical and computational accuracy, but subsequently to select items for examination as well. In other words, they can convert the idea and techniques of "management by exception" to permit "auditing by exception" as well. They can develop standards and criteria of normalcy (or suspicion), state them in numerical terms, use EDP programs to screen and evaluate transactions and results, identify those which violate the pattern and select them for further investigation. They can, in short, apply the same types of criteria and analytical techniques which the auditor himself would normally use—but instead have the machine do this initially with data and criteria which are in machine sensible form.

To learn and to prepare for the future, these approaches must be applied. When stated as they are above, they seem deceptively simple. But good people are hard to find and train. Good ideas are hard to develop and use. On the other hand, is is equally true that as good people are trained and good ideas are applied, new opportunities appear, tests become more complex and comprehensive and electronic audits become more selective and more fruitful.

To start five or ten years hence would, it seems to me, be a mistake. Audit techniques should be developing at least as rapidly as the problems they are designed to solve. The time to start is, at the latest, now.

### CONCLUSION

This, then, would seem to be the present and the prospect. Special purpose auditors (with the tax examiner as one of the most important and the most numerous) may expect to have a uniquely difficult task in the future if their present standby—the document—follows its presently indicated course. They can probably prevent their problems by insisting that documents, registers, lists and forms be produced in substantially their present manner. Since this may sharply alter or restrict progress in EDP, it seems logical to hope that special purpose auditors will not require this course of action except as a last resort.

Fortunately, acceptable alternatives do seem to be available. They may, however, require some major administrative and organizational changes and some substantially new audit approaches as well. The job ahead is big enough to make it desirable to make a strong start upon it as soon as possible.

## DISCUSSION NOTES

Most of the group felt that for purposes of ordinary tax audits administrators were vested with sufficient discretion so that they could rely on an automated system, if they were convinced it was sound. The suggestions offered by the paper on how the auditor can go about convincing himself were discussed and quite generally accepted. The " flow " aspect of automated accounting came in for more thorough examination. This phenomenon called for more timely examinations of procedures employed by the taxpayer population. This would be true for both the " procedure " and " input " aspects of a given system, but for different reasons. Procedures would have to be subject to timely checks because they change and are often difficult to recreate and comprehend at a later date. The input process would have to be frequently checked to see that, given an appropriate processing procedure, the right data was going in.

An objection was made that all this might not be necessary since most controversies centered around general ledger items (inventory evaluations, deferrals, and so forth). In rebuttal, it was suggested that to neglect the procedures which go to produce these principal items would be a mistake. Differences in tax versus financial accounting were criticized as complicating matters. However, these differences were defended on policy grounds and reinforced the idea that to be able to explore underlying procedures was even more vital.

Matters of substantive law appeared to pose the greatest problems. Doubt was raised whether it would be possible, legally, to force an audit of a company's procedures before the tax liability was determined. Would this make " timely " audits impossible? In addition, document retention laws would have to be re-examined and revised. But what was regarded as clearly the greatest problem was the possible impact of lack of " hard copy " records on tax litigation and tax fraud prosecutions. EDP media records often are thought to be contrary to the best evidence and hearsay rules. This and general judicial reliance on " signatures " were conceded to be grave im-

pediments to progress in the whole field.

Thus, as EDP equipment takes over more and more of the paper handling and information processing in business, the auditor (both the independent public auditor and the special tax auditor) must learn to work with less and less documentation. This can be accomplished by determining the reliability of the system and of the input data so that the output will be acceptable without " hard " documentation.

# THE IMPACT OF ELECTRONIC DATA PROCESSING ON ADMINISTRATIVE ORGANIZATIONS

CHADWICK J. HABERSTROH *

We are just beginning a period that is suggesting to us new ways of constructing systems and new ways of making decisions in organizations. This is, in turn, suggesting new requirements in computer design, and perhaps new requirements in organization design. (p. 95)

Earlier distinctions between "data processing," primarily in business, and "scientific computation" for engineering and research, are being replaced to a considerable extent by a "systems" point of view toward most areas of application. (p. 81)

. . . we may find that man-machine-computer systems will handle some aspects of business in ways with which systems without computers, or businesses which have failed to program the proper functions, will find it difficult to compete. (p. 80)

. . . the tendency is for managers to consider the data-processing facility as an afterthought, if at all, rather than as an integral part of operations. (p. 205)

Resistance to change exists as a universal phenomenon in organizations, and its presence is felt strongly in every phase of information technology. (p. 208)

The computer may turn out to be more competitive, economically, with scientists than with executives; and more competitive with executives than with clerks. (p. 65)

The computer and associated technology will make its greatest contribution not through a direct attempt of application as such, but by stimulating the analysis of systems by which companies are operated. This, for many companies, means breaking down traditional organization curtains and a no-holds-barred pursuit of problems. (p. 166)

The management function will undergo profound changes or mutations, most of them in the direction of increasing the personal requirements of the manager. (p. 212)

. . . middle management may find it necessary to become quite highly professionalized with a resultant fluid interchange between line and staff positions. . . . It becomes tempting to suggest that the ultimate outcome will be professionalization at top-management levels, a movement which might be compared to that of the earlier owner-managers to today's salaried executives. (p. 86)

On balance . . . the pressures on top managers are likely to increase, since their actions will be subject to a more detailed check than ever before. (p. 19)

The important training problem of years to come will not be training young people prior to their entry into occupational roles, but helping people in the middle of their careers, as the body of knowledge grows generally and in the area of their speciality. (p. 34)

. . . "information technology" will be a force for centralization of decision making, along with an expanded staff at the top levels and fewer jobs, with more highly programmed content, at lower levels in the management hierarchy.

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> . . . an important dimension of information technology is the ability to collapse the planning period which has been traditionally accepted in business as inevitable. (p. 158)
>
> . . . the language of organization which we have been using for years has become obsolete. In particular, the term staff no longer has any precise content.[1] (p. 102)

THESE quotations are all taken from the proceedings of a seminar on management organization and the computer held in 1959 under the auspices of the University of Chicago Business School.[2] They represent in concrete and sometimes dramatic terms the best guesses of a number of experts in computer technology as to what will happen in the business world when new developments in the techniques of information processing have had time to run their course. In spite of the multifarious differences between typical business organizations and the type of government bureau that administers the tax laws, there are also some similarities that make it possible for tax administrators to learn from the experience of business. Quite beyond any question of similarities, the forces generated in society by any historical process of the magnitude reflected in the above quotations cannot help but have an impact on all phases of our national life, including the work of public agencies.

This paper is directed to the task of exploring and interpreting the above and other prognostications. In doing so, we will take for granted the picture of information technology implicit in the above quotations and dwell upon the organizational factors that will interact with the new technology to produce the organizations of the future. The theory of organization to be drawn upon is a synthesis of much recent research in the behavioral sciences,[3] which is now finding acceptance in the newer textbooks on management.

### *The Organization as a Task Oriented Social System*

The bulk of the current literature on computer applications focuses on the tasks to which the computer can be applied. This may consist of surveys of how the job is done or analyses of how it can be done better. This focus is also evident in the papers presented at this conference. Sometimes, but not typically, the discussion is carried as far as the human problem of using the new technology to get the task done.

The " how to do it " focus is dictated of course by the mutual interest of both the writers and the readers of this literature. Most of them work in organizations and on just such tasks as are described. A large portion of work in this field is necessarily done by people with a thorough knowledge of computers and programming techniques. Other writing may rest instead or as well on an expert knowledge of the field to which the computer application is being made. As more and more applications take place, however, there has occurred a greater realization that characteristics of the organization as a social system are exceedingly important determinants of the outcome. These factors arise from the " human nature "

[1] George P. Shultz and Thomas L. Whisler, eds., *Management Organization and the Computer*, Free Press, 1960.

[2] *Ibid.*

[3] The main outlines of this synthesis may be found in James G. March and Herbert A. Simon, *Organizations*, Wiley 1958, and Albert H. Rubinstein and Chadwick J. Haberstroh, eds., *Some Theories of Organization*, Irwin-Dorsey, 1960.

of the individual members of the organization and also from its "organization nature" as a system of action.

It is not hard to concede the existence of these factors, nor even to go further and recognize that they govern the choice of tasks and the application of the technology. One can accept these points and then ignore them by relying on the magnificent degree of flexibility for which the human being and organizations of human beings are well known. But if people and organizations are adaptable, they are also rigid. If change and new patterns can be imposed, they can also be resisted. Successful organizational design is not likely to be achieved by the same techniques used in designing a machine or in programming a computer. Rather, it requires some degree of recognition of the fundamental laws that govern such systems. Nevertheless, many designers in the scientific management movement insisted on treating people like machines, and many designers of the electronic computer school are undoubtedly trying to program them like computers. The result then and now is a limited degree of success and an enormous degree of waste.

### *Task and Technology*

Our first problem is to explore the meaning of the new information technology itself for the organization and its members. To do this, we will need three levels of concept. We need at the first level the idea of the objective possibilities for action. This we must distinguish from the second level, the present state of the art, society's knowledge of the techniques for action, which we will label *technology*. The computer experts assure us that contemporary developments have extended objective possibilities well into the domain of what used to be pure fantasy and well beyond the present state of technology. An acceptance of this point has been a great stimulus to research in computer hardware, programming technology and systems analysis. It is hard to say whether society will ever close the gap between its established technological ability and what is believed by experts to be possible. It is equally hard to say that technology has not already outstripped the general public's perception of the possibilities for action.

The distinction between the state of the art and public appreciation thereof brings us to the third level concept and the most important for the remainder of this analysis. This is the *task model* of a particular organization, one of the systemic characteristics that influence organizational behavior. The *task model* is the organization members' shared perception of what the task is and how it should be accomplished. A given task model may incorporate the latest technology or it may be quite archaic. In any concrete case, it is almost inevitable that at least some elements of the task model will lag appreciably behind the best available technology. Nevertheless, the most important influence on any organization task model is the state of technology and the research process in society as a whole. The problem of innovation into specific organizations is a secondary consideration. This is even true in fields where technology is changing rapidly and substantially.

Technological advance is never limited to one field; an advance in one area generates needs and ideas that inspire work in other fields. Just as advances in computer hardware stimulated the de-

velopment of programming techniques not dreamed of by the computer's inventors, so the development of the whole field of information technology is stimulating applications to organizational problems, most notably in systems analysis and simulation. We must not, however, make the mistake of regarding the computer as the only impetus to change in organizational techniques. Consideration of the psychological factors inherent in work relationships has inspired such innovations as job enlargement, participative management, profit sharing, group incentives, Scanlon plan, employee centered supervision, etc. The growth of organizations in recent times to their present enormous sizes has generated another group of techniques designed to achieve decentralization and control. These and other organizational developments interact with developments in information technology and with developments in all other fields to create opportunities for innovation and oftentimes considerable economic and social pressure to do so.

If research does not automatically result in innovation, it would be well to mention right at the start two perfectly rational factors that preclude this. The first is the organization's commitment to sunk costs. It takes time, effort, and resources to build a new technology into an organization. This is quite obvious when the technology is incorporated into machinery or buildings. Present machinery at scrap value may give service at lower cost than new and superior machinery that would have to be bought at manufacturers' list prices. Or a forecast of further technological change may prevent any adoption of intermediate forms of technology. These same considerations apply equally well to aspects of the task model that are not incorporated into physical capital but are situated in the beliefs and practices of the personnel. These also represent sunk costs and any attempt to change them will require further expenditure. In addition to these rational factors, there are other barriers to innovation that arise from the social character of the organization.

### *Social Aspects of the Task Model*

The task model has been defined above as a shared way of perceiving and acting in relation to the purposes of the organization. It includes not only such things as instructions for doing the physical labor involved, but also beliefs as to who should give or change instructions, limitations on the range within which instructions may be given, perception of the purposes and subgoals of the organization, standards of performance, etc. These ideas taken as a whole form a consistent and unified pattern of response. Each individual knows a portion of the task model in great detail and has at least some general knowledge of the remainder. He holds these ideas in cooperation with others, perceives the others as depending on his knowledge and himself as depending on the knowledge of the others. The fact of sharing his ideas with his fellows provides " social reality " for them, i.e., gives him an acceptable basis for believing in the factual or moral correctness of these ideas.

Certain characteristics of the task model itself may greatly modify its susceptibility to planned revision or unplanned gradual evolution. Any organization has some capacity for change built into its task model directly. This may be something as routine as the replacement of workers by other workers.

On the other hand, an organization may use a research and development branch or an organization-planning office for the specific purpose of routinely generating changes in the technical or organizational aspects task model. Any organization, however, will exclude some parts of its task model from deliberate review and change. In many organizations this even extends to the identity of individual occupants of positions above the lowest level. Any death or resignation poses an un-planned-for problem and the task model is patched up from crisis to crisis. Thus there can be a considerable range of variation in the degree to which the task model is statically or dynamically oriented. Many, if not most, organizations tend to regard their task as fixed and their way of going about it as the most efficient possible. The increasing pace of change in our society may, however, be pushing more organizations into incorporating dynamic elements into their task models.

One of the most fundamental findings arising in many studies of organizations is the tendency of their members to place a positive value on the procedures they use. This goes beyond the fact of valuing procedures as means for the achievement of ends. Although the task model of a successful organization is unquestionably a valuable property in this sense, this tendency of personnel to value and defend their specific ways of proceeeding has often been found to impair the realization of the over-all purposes of the organization. When this phenomenon comes to public attention it is labeled " red tape " and universally deplored. It is not always easy, however, to distinguish between the virtue of a workmanlike concern for protecting and maintaining one's tools and the sin of an idolatrous attachment to the same objects at the expense of legitimate values.

The problem of a purely emotional attachment to means is compounded in the organization situation by the overriding need for stable organizational norms as a basis for effective operations. Effective, coordinated action is possible only if members can form reliable expectations as to the performance of those others who must enable or complete the work. The problem is further compounded by the possibility of a genuine conflict of interest between the organization as a whole and any particular individual or group in it. The case of the skilled employee whose status and material welfare are based entirely on his virtuosity in organizational practices that may be rendered obsolete is the most obvious example. The same principle applies at top management levels, too, although different aspects of the task model would be cathected.

It is not necessary to look up on oldtimer in the organization to demonstrate the operation of this principle. Computer technologists are frequently criticized for lack of realism in their applications. There is no reason to think that this is all a plea for the defense. Computers, too, are easy to fall in love with, and a computer technologist probably would not be in that field if he did not have an appreciation for the sheer abstract beauty of a rigorously logical and efficient programming job. It is also possible for him to develop an unreasonable attachment for the techniques that he learned in school or for a previous successful solution to a somewhat different problem. These things may create an inability to adjust to realities outside of the expert's own model and

a resulting tendency to demand more adaptation from others than is really necessary.

Personnel accustomed to the existing organization procedures, on the other hand, are impressed with the demonstrated workability of old procedures, the ease of working with what is familiar as opposed to the disruption and uncertainty of a proposed change. The old way may be what *they* learned in school, or it may be the same procedure followed by other organizations.

The net result of the strong defenses against change found in most organization's is preservation of the *status quo* against all but minor evolutionary changes, except under conditions of crisis. A number of studies have shown a direct relationship between felt stress of organization members and their willingness to innovate. It may be expected that the more profound types of change will occur only under stresses uniformly regarded as serious by all relevant personnel.

### *The Impact of Information Technology on Task Model*

Viewing information technology as a possible change in the task model of an organization, we can define two alternatives for effecting the change. New personnel can be brought into the organization who have a prior commitment to the new elements in the task model, people having prior training in computation methods or experience with applications. Alternatively, an effort can be made to change the task model of present members by training programs or reinstruction on the job. Either method of change could be accomplished within the structure of the current task model, by invoking recruitment programs in the first case or established indoctrination procedures in the second. This is not to say that the changes are all thought out in advance and integrated with the old task model. On the contrary, once a commitment to a certain degree of change is made, it is likely to carry the organization farther than was originally intended. Unforeseen problems and newly opened opportunities will stimulate new activity. On the other hand, what might at any stage seem like a logical extension of a new program may encounter resistances of the type suggested in the last section. Resistance may not only block extension, but may also prevent realization of anticipated gains even though the change has apparently been successfully made. This blockage may be permanent unless the interests that are being defended can be discovered and effectively neutralized.

Whether change is introduced by new personnel or not, the new elements have to be related in some way to the existing task model in the on-going organization. How this relation is structured and which personnel option is chosen are important factors in determining the depth to which change will extend and the smoothness with which it will be executed. Conversely, these choices become the first arena in which the policy of commitment to change and the nature and strength of vested interest are tested out.

The most common way of introducing computer technology into an existing organization seems to have been to regard it as a substitution for clerical labor. Management is used to considering working-level personnel as means to get the task done. Accustomed to dealing with labor turnover and the sub-

stitution of different kinds and degrees of skill and with the acquisition and replacement of various types of office equipment including complex mechanical punched card equipment, management finds it easy to contemplate a new type of machine and a few new skills as an economic substitution for an old way of doing the job. The definition of the job, however, and the procedures for accomplishing it do not necessarily change. Management may still preserve its old way of doing things, merely accomplishing this with a different balance of labor and equipment. Such organizations typically even have a procedure for getting rid of redundant personnel involving reduction in force by attrition and retraining of present personnel. This approach causes minimum disruption and need not require the hiring of a single technical expert, if training and outside consultation are preferred.

Sometimes an economic application requires a genuine rethinking of the work-flow system. Organizations that have gone so far as to take this step have usually estimated that the systems study generated savings of the same order of magnitude as those yielded by the mechanization itself. This process encounters more resistance, however, and the resistance comes from more powerful places. If the innovation is being implemented as a departmental program (in business it is typically a part of the controller's department), it is fairly certain that the rethinking of procedures will stop at the boundaries of that department. Even if the innovation proceeds from a broader mandate, management will frequently still go to great lengths to avoid violence to such parts of its task model as the number of departments in the organization, the autonomy or duties of important managers, the functional basis of departmentalization, etc.

The redesign of a work-flow system is a task that an organization is not likely to undertake—unless it has previously developed a high degree of sophistication about planning—without bringing in new members who have the appropriate specialized skills. Computer experts can frequently make the necessary contributions in systems analysis, and most systems analysts come prepared with a thorough understanding of modern computers. Thus, an organization that contemplates work-flow redesign would tend to bring in new personnel with these skills to achieve it; and—conversely—an organization that brings in computer technologists is likely to find that it has created pressures toward a thorough replanning of work-flow systems. The result of innovation will frequently include unanticipated consequences as the innovation impinges on more narrowly organizational aspects of the task model (discussed in the next section) and mobilizes the defensive interests vested therein. Nevertheless, fairly profound changes in work-flow can be implemented without compelling a re-examination of the organizational aspects, as managerial ingenuity discovers ways of reconciling the new with the old.

Some organizations do go so far as to review basic, organizational features of their task models. This has arisen most frequently in the past from crises in organizational effectiveness, rather than from computer innovation. As experience with electronic data processing grows, we can expect to see more experimentation with organizational forms and adoption of some (perhaps those sug-

gested in the introductory quotations) as especially appropriate in conjunction with new methods of information processing. From past experience with organizational changes, there is every reason to expect that the economic gains from innovation in this area are also of a large order of magnitude. If so, we must expect long-run pressures toward improved organization, as well as toward better work-flow systems and computer applications.

These points are illustrated in the papers in this series. Most of the IRS applications seem to be planned as an application of more highly mechanized techniques to the predefined work program, with a new element (the central file) yielding some benefits not previously feasible. The system still retains many anachronistic vestiges of the old program, for example, initial processing of returns by decentralized district offices although computer economics has dictated that all mechanized data processing be conducted at a more centralized (regional or national) level. IRS envisions mechanization of the function of selecting returns for audit, a move already begun by New York State; this is a relatively radical innovation in the workflow model of a tax agency in terms of its impact on the work force and the administrators' habits of thought. This cannot be said of the proposed central file functions, which are something any tax administrator would like to have been doing all along.

It may also be noted that the move to mechanized selection of returns for audit by New York State was reported as arising from the failure of the old audit system. Can this step be planned in other tax jurisdictions in the absence of a threat of imminent collapse?

The problem of " departmentalization of change " mentioned above appears in almost all the papers in this series in an especially difficult form. The coordination needed is between essentially separate organizations: state and federal tax agencies; IRS and Census; IRS and Social Security; reporting companies and tax offices; etc. Each unit adds to this problem its own defenses against change. The conference has developed a number of valuable ideas for this type of coordination, but their availability is not enough. Change in task model requires resolution of many forces (by happenstance or by deliberate administration) even after the generation of an apparently intelligent new program.

*Organizational Features of the Task Model and Their Relation to EDP*

Many ideas as to how an organization should be set up achieve a high degree of acceptance in society. Certainly the most widespread and venerable of our ideas about organization are those of " line " and " staff." Others like " decentralization " enjoy only slightly less popularity. For others, like the principle of " functional specialization," there may be widespread agreement coupled with diversity of opinions as to what functions should be specialized. Other ideas, such as " task force " or "project " organization, are less widely appreciated. None of the ideas mentioned above owes anything to the development of electronic data processing. On the other hand, the presence of data processing techniques may determine whether a given form of organization will succeed and vice versa. Several of our introductory quotations speculate on the compatibility of specific organizational

forms and information technology. These refer to long-run solutions; what combinations will occur immediately will be largely a matter of historical accident, although conscious experimentation cannot be entirely ruled out.

An important set of questions concern the implications of EDP for decentralized organizations. Decentralization appears to have developed historically as firms grew very large and were still forced to adapt to changing conditions in order to survive. The essence of this innovation in task model is the establishment of a substantial degree of autonomy in decision-making at a department level, reserving only certain functions to top management. There are two main aspects of this innovation that require analysis. Both are conditioned by the fact that decentralization did not supersede the older concepts of line authority, but instead was tacked on and made consistent with them.

The first line of analysis starts from a principle in control theory. One way of stating this is that where a complex job of regulation must be done, a regulator of commensurate complexity is required. The operations of a large organization require a degree of complexity that cannot be attained by a single top manager or management committee. With increasing complexity, a single man or committee cannot even cope with it on the basis of a distinction in the task model between "important" and "routine" matters, leaving "routine" to be dealt with by subordinates according to rule. However, I think there is evidence to show that the older concepts of the line system prevented management from perceiving decentralization as a transition from one-man or committtee rule to rule by a complex executive organization. Although decentralization placed great weight on the decisions of department managers, the "line" concept prevented them from being regarded as an integral part of top management, and their relations with the rest of top management regarded as an organized system. Thus we might surmise that a substantial part of the effectiveness of decentralization stems from the organizational characteristics of this complex executive system, rather than from any magic in the process of "delegation." If this is so, these relationships are themselves susceptible to systems analysis and computerization. Such a process would undoubtedly force restructuring of the division manager's functions as part of top management. It would also reduce the number of personnel required at this level and give more effective control over subsidiary operations. Such a development would certainly be viewed as "centralization."

Another line of analysis concerns an alteration in personal relationships between general manager and division manager. Under decentralization, although the nominal line relationship was maintained, the "responsible" officer in general management was not engaged in "supervising" the work of the division managers in any meaningful sense. The results of freeing a subordinate from direct dependence on and subservience to a superior have been studied intensively, mostly by psychologists. The results that can be reliably expected are increased morale, self-reliance and initiative on the part of the subordinate. This in turn can be a source of increased efficiency. If centralization should occur because of improved information technology and within the concepts of

the " line " system, then this second trend could be reversed with concomitant reduction in the degree of improvement to be expected. The inherent fallacy in the line concept is the equating of a department with its head officer. If this equation is accepted, then top management's very real need to maintain control over the organization is resolved into a need to maintain domination over the man.

The principle of functional specialization is wellnigh universal in organizations, as is the idea of calling some of the functions " staff." Some specialties, like accounting, finance, production, sales, purchasing, are almost equally universal, but a great deal of variety can be discovered after one leaves these domains. Research and development, manufacturing analysis, operations research, training, and planning are all sufficiently widespread to be recognizable, but are nothing like universal among organizations. The older specialties have a firm social base in professional or educational institutions. The newer ones are gradually attaining that basis. Information technology itself is generating some such bases of specialization.

When specialists are needed in small numbers, they are usually designated " staff " and asked to advise some line executive. The " staff " designation in an organization committed to the concepts of the line system permits expert advice to be used centrally, yet denies the advisor the power and status inherent in central line positions. Staff designation also can provide the same kind of autonomy that decentralization gave to the subordinate line manager. Both the central position of staff and their autonomy can help organization effectiveness. As the work-load of a staff speciality increases, however, additional personnel are required and systems of super- and subordination develop. Soon a complete department is in existence with chief officers largely engaged in administration. This blurs the distinction between line and staff specialities and eliminates any advantages that might accrue from staff autonomy. At this level of complexity, the line-staff concepts again obscure the *de facto* organizational and work-flow arrangements that undoubtedly, as in the case of decentralized organizations, contribute to the effectiveness of the organization as a whole.

The information handling capacity of computer systems may give added impetus to the choice of planning as a strategic function around which to build a department. In the past, planning has most commonly been relegated to the darkest " staff "corners. Plans have been accepted only with the approval of top line management and that approval has not usually been easily given. As such activities have proven their worth, however, they have tended to take on more and more *de facto* autonomy. The culmination of this process can be seen for example in the cases of the Atwood Vacuum Machine Company, which has assigned a planning unit action responsibility for the coordination of job-lot cost estimation, manufacturing, and purchasing, and the International Shoe Company, which has its planning unit coordinate sales estimates, production, inventories, and purchasing.[4] In both reports, the company officers specifically mention rejecting the previously held idea of planning as a " staff " function.

[4] Schultz and Whisler, *op. cit.*

Another organizational innovation, which has received some recognition as a means of introducing computerization, is the "task force" form of organization. The rationale here is that a specific task is assigned to a relatively small group which is expected to be disbanded upon completion. The strong point of this form is its flexibility in permitting people of different interests and abilities to be grouped together with very close coordination among them. Another important feature, perhaps equally significant, is the fact that each individual retains his identification with his "permanent" functional department. This is undoubtedly conducive to a retention of specialized skills in the new situation and also serves to free the individual from excessive subordination to the task-force director. Some authorities go so far as to recommend systematic rather than *ad hoc* use of task forces with the permanent functional organizations serving as a corps of technically competent manpower to be allocated to the task forces.[5]

Another aspect of task force or project organization is the necessity for giving a coordinative function of very broad scope to a comparatively low-level manager. This form and decentralization both have the merit of providing appropriate experience for senior management positions. The same cannot be said of the strict "line" system that keeps individuals working within one narrow specialty even though at fairly high organizational levels. The success of the newer organizational form in task accomplishment and in management development raises the question as to whether management itself is not a function that could be specialized, professionalized, and organized into a functional corps. This seems to be well within the range of possibility and is a basis presumption of the more forward-looking programs in university education for business.

*Dynamics of the External System*

Although we are primarily interested in consideration of the internal administrative system, perhaps some additional attention needs to be given to the ecology of the organization. Earlier we gave some attention to the development of new knowledge in society as an influence on the innovations made in the task model of a specific organization. Going somewhat further than that, the environment can compel innovations as well as make them possible, if the innovations do in fact permit lower cost operation. In the case of business firms, the forces of competition and the quest for profit create this pressure. In public administration, administrative and political factors tend to produce the same effect.

In addition, the social environment conditions the pressure toward and direction of innovation by creating external economies, services available from outside at lower cost than a single organization could provide them internally. The development of a profession is one instance of such a factor that influences forms of organization. The profession, as a social entity, lowers the cost to any given organization of employing professionals by itself examining the degree of qualification of personnel and enforcing standards of conduct. By standardization it permits technology developed

[5] Bernard J. Muller-Thym, "Practices in General Management, New Directions for Organizational Practice," *Journal of Engineering for Industry* (Part of report, "Ten Years' Progress in Management, 1950-1960").

in one organization to be transferred to another and—beyond this—it provides, through educational programs, meetings, publications and informal contacts, the specific means of communication by which this transfer can be effected. Increasing professionalization will thus have a considerable impact in determining the direction and speed of innovation.

In addition to or aside from professionalization, as the process of administration becomes more and more complex, many organizations may find it necessary to make use of training facilities and consulting services from outside. The type of service available may well exert a significant influence on the type and amount of innovation.

Another hypothesis, and a most intriguing one, is suggested by Alan O. Mann.[6] He envisions that information processing will tend to become a regulated public utility, with standardization of format and equipment permitting encoded transmission of data between supplier and customer, tax office and taxpayer's accounting office, etc. Data processing for small business and individuals would be contracted for by banks, credit agencies, or accounting firms.

Future developments may also exert a substantial influence on our society's mores concerning occupations. As the norms change, organizations will encounter pressure to which they must adapt. Consider the influence of professionalization on the present notions of " career " and " status." Now it is customary for an individual to commit his career completely to one organization, and consequently be rewarded with a degree of managerial control over the organization's affairs. The most radical prospects would appear to be a divorce of managerial functions from organizational status and an acceptance of mobility between organizations as a normal step at any stage of a career. If these developments should happen in future society, the " organization man " would go the way of neanderthal man and many of our most widely accepted " principles " of administration would follow him into oblivion. Although it is precarious to make specific guesses, even as specific as these, we can be certain of profound change in social norms in the context of our working lives within the foreseeable future.

[6] Donald G. Malcolm and Alan J. Rowe, eds., *Management Control Systems, Proceedings of a Symposium Held at System Development Corporation, Santa Monica, California,* Wiley, 1960, p. 245 ff.

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DISCUSSION NOTES

A dim view was taken of the idea that an " activist " policy in the face of political pressures would bear fruit. But there was a general agreement on the spirit with which incorporation of EDP should be approached. Employee morale problems created by EDP were discussed particularly with reference to the alleged need to import technical personnel and place them in positions of authority. While, to a certain extent, this was regarded as inevitable, some were able to report that considerable success could be expected if careful search were made within the organization to find and train men with the proper aptitudes.

Then the discussion centered around the type of person selected to head up the program. Often, since there are no " technically trained " personnel within the work unit and an " outsider " must be brought in, this should not preclude the use of an " insider " with good administrative ability as over-all co-ordinator of the project. Of course, the rigidity of civil service requirements in both the state and federal governments present definite problems relative to bringing in qualified personnel, or getting rid of " unnecessary " personnel. For example, IRS wanted to retain the district officers as enforcement officers only, with all the processing done at regional and central levels; for political reasons, this was not feasible.

On the subject of the long range influences of data processing on organizational structures, the following ideas were offered. The science of data handling is becoming professionalized. The agencies of the future may consider the maintenance of an internal computing installation in the same way they now regard the maintenance of an independent power supply. The overlapping interests of business, industry, education and government in the same general data point sharply in this direction. Greater individual reliance upon others, such as banks, for the keeping of personal records also tends to accelerate the move in this direction. The impact of such a change on administrative organizations, while not clear in detail, would certainly be far reaching. There was a feeling that the impact would at least radically alter the present personnel problems attendant upon data automation. There was virtually complete agreement that tax administrators had to be sensitive to movement in the field whatever the precise final direction.

The consensus of the conference appeared to be that this was an extremely important problem area, but a difficult one that must be dealt with almost on an individual basis, and that the problem warranted additional study.

# ELECTRONIC DATA PROCESSING AND TAX POLICY

WILLIAM VICKREY *

DOES EDP open up possibilities for reforming the way in which tax liability is defined? At first blush, it would seem likely that a number of procedures might become available which are desirable in principle but heretofore have been thought to be either too complicated or too costly to carry out, relative to possible improvement in equity or reduction of undesirable repercussions. On examining the matter, however, it seems quite likely that there are few if any cases where a sound solution to a tax problem involves procedures and computations that could not be handled adequately by pre-EDP procedures, given a genuine desire for the reform and a modicum of ingenuity in devising procedures. The opportunities that EDP seems to offer may thus be largely illusory. On the other hand, changes are taking place in association with EDP, and if this can be made the occasion for bringing about reforms that have long hung in abeyance, however irrelevant the facts of EDP may be to the reform, the illusion may well generate a reality.

## *Averaging: Cumulative Assessment*

Suppose we begin with my own pet area, that of averaging. The advantages of a general averaging provision in eliminating the inequities associated with the assessment of fluctuating incomes on an annual basis are fairly well known. Not so generally realized, however, are the further advantages which certain types of averaging have in dealing with a whole host of other problems where the question of the timing of the realization of income to the individual taxpayer is involved. Cumulative assessment, for example, is a special form of averaging that offers a simple, comprehensive, and sound solution to such problems as the treatment of capital gains, including tax-free exchanges, involuntary realizations, wash-sales, and tax-free distributions; the treatment of pensions, social security payments and deferred employee compensation of various kinds; the provision of retirement benefits and allowances for the self-employed; the treatment of life insurance premiums and proceeds; the retention of undistributed earnings; personal holding company manipulations; retention of earnings abroad; and the whole area of depreciation, obsolescence, and the writing off of expenditures for development and improvements.

Mention of averaging of income for income tax purposes, or "cumulative assessment," for that matter, often seems to conjure up a picture of a massive file maintained for each taxpayer, in order that the computations requiring current income to be combined with that of several years in the past can be checked. But many averaging schemes can do with the mere carrying forward of as few as three figures from the return for the immediately preceding year, and moreover

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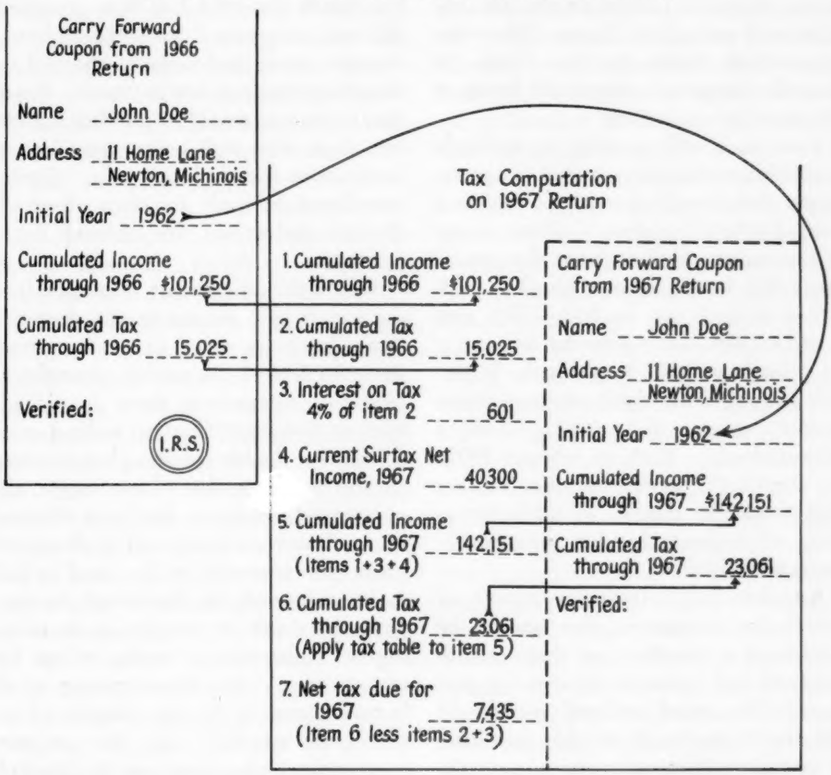
this carrying forward of the information can be done without the reorganization of the files to bring the taxpayer's life history together, desirable as this may be for other purposes. If the advantages of averaging are wanted, they can be had, with or without EDP. EDP may facilitate the use of some of the more cumbersome types of averaging, but these more cumbersome types are not necessarily superior, and the effect of EDP may even be to permit an inferior type of averaging to be adopted where without EDP a superior type of averaging might eventually have come about because of the need to preserve simplicity.

To be specific, cumulative assessment requires that three items be brought forward from the previous year's return: (1) the year in which the averaging period begins, (2) the present value of all tax payments made with respect to this period, with compound interest credited from time of payment to the present, and (3) the aggregate net income, after exemptions and deductions of all the previous years in this averaging period, adjusted to include the interest credited on the tax payments. From these three items, in combination with the net taxable income reported on the current return, are derived the current tax due and the corresponding three figures to be carried forward to the subsequent year. The computation is a simple and straightforward one, not significantly more difficult than the typical computations already required on form 1040. Even without EDP or the rearrangement of files, the administration of such a cumulative assessment scheme might be carried out fairly simply as follows: On completing his tax return for the first year of an averaging period, the taxpayer would copy on to a coupon attached to the form the three critical figures to be carried forward, with of course his name and identification. For this first year, these would be simply the year, the tax for the year, and the net income for the year. On receipt of the return in the tax office, agreement between the figures on the coupon and those appearing in the body of the return could be checked, the coupon stamped to certify the agreement. This coupon can then be detached and either returned immediately to the taxpayer, or possibly enclosed with his refund check, or perhaps best of all filed away according to the initial year of averaging, and then later used to serve as the address insert in mailing the tax forms to the taxpayer the following year. In this way the taxpayer would be sent only the forms and tables appropriate to his particular averaging period. This coupon would then be used by the taxpayer in filling out his next year's return, and enclosed with his return along with withholding certificates and the like so as to permit immediate verification of the return.

If all goes according to protocol, there is not very much for EDP to contribute here. Conceivably the certified coupon could be emitted as part of an EDP processing procedure without requiring the taxpayer to copy the figures. Or possibly EDP would make it worthwhile to perform the tax computation in the tax office, thus making it unnecessary to see to it that each taxpayer gets the particular tax schedule appropriate to his averaging period, and avoiding the possibility of the taxpayer using the wrong tax table. But the gains are not such as to be decisive for or against the adoption of averaging.

## Appendix I.

### ILLUSTRATION OF PROCEDURE FOR CUMULATIVE ASSESSMENT




There may be more advantage to EDP in dealing with the inevitable cases where something goes wrong. The taxpayer, for example, may claim to have already started an averaging period and show previous tax and income on his return without enclosing the appropriate certificate. This may be because he has mislaid it, as is likely to happen if the certificate is mailed to him immediately upon the receipt of his previous return. Or it may be that he never received it, which may happen if he moves and his mail is no longer being forwarded, which is particularly likely if the certificates are mailed with the forms for the next year, after a lag of six to ten months. (Do we have any information on the relative number of the mailed out returns that (a) reach the taxpayers, and (b) are used in filing? By type of return?) In many if not most cases it will be possible to spot erroneous claims immediately, since the initial averaging year and the cumulative income together uniquely determine the tax that should be reported, and most erroneous claims will show an inconsistency here that can be readily detected. It will ordinarily take a fairly sophisticated taxpayer to make an erroneous claim that will stand up under

this check; moreover even if the claim is erroneous, if it is consistent, it will have a substantial effect on the net taxto be paid only if the figures differ very substantially from the true figure, so that the danger of substantial fraud at this point is not serious.

Even so, it will probably be desirable to check a substantial number of the returns that are filed without certified carry-forward coupons. (How many of the returns filed without the appropriate W2 forms are now checked back before refunds are made?) This step would require looking up the return for the prior year; EDP would make it possible to program a check of these claims against a master file prior to issuing a refund check. With or without EDP, the checking against prior year returns filed in another district would be something of a headache, but presumably less so with EDP.

Another administrative aspect of cumulative assessment that should be mentioned is its effect on dealing with reopened and amended returns for past years. The usual offhand picture in this area is to the effect that any kind of averaging immensely complicates the picture, since, it would seem, the revision of the income assessed for a previous year will require adjustments for all subsequent years for which that year forms part of an average income. Actually, with cumulative assessment and possibly also with some other forms of averaging, the picture is quite the reverse. If for example an item that should have been included in the income for 1958, say, is discovered in 1961, then all that is necessary, with cumulative assessment, is to add the item to the income for 1961 (or for 1960, if that return has not yet been filed); the effect is substantially the same, including interest charges on the unpaid tax, as if the return for 1958 had been reopened, the tax recomputed for 1958 and subsequent years, and interest charged on the delinquency in tax payment. Penalties, of course, would be another matter, but these may well be computed separately from the tax in any case. Similar considerations apply for cases where additional deductions are claimed for a prior year.

Where the adjustment to income is in the nature of a change in the depreciation allowance, or of expensing versus amortization of an outlay, cumulative averaging offers even more drastic administrative simplification: as long as no omission or double counting has occurred on the books, so that, for example, the excessive depreciation has been reflected in a reduced tax basis, and if all capital gains are eventually to be taxed in full as income (with the demise of the taxpayer by death or emigration occasioning the realization of market values for tax purposes) then no correction at all is needed merely for the purpose of assessing the equitable tax: for tax purposes proper the error can be ignored. The only administrative step that needs to be taken is to assess an appropriate mild penalty for the purpose of inducing taxpayers to keep their accounting practices within reasonable bounds and their tax payments reasonably up to date.

The one place where the impact of EDP on the prospects for cumulative assessment may be most significantly felt is probably at the bottom level where the question arises of how to treat incomes below the exemption level. Heretofore, in this area, administrative considerations have usually been held to

justify a departure from the strict principle of averaging. In one direction, it is not too difficult to provide for the refund of past taxes paid to persons whose incomes subsequently fall below the exemption levels. Moreover to do this has particularly desirable consequences, both in providing additional built-in countercyclical flexibility in the tax structure, and in providing a form of supplementary retirement income. But in the reverse direction, to allow unused exemptions to be carried forward for tax abatement means that a tax liability will be made to depend on information which was not only reported, if at all, on returns some considerable time previously, but audited, if at all, under circumstances such that it was not clear at the time of audit that a tax liability would ultimately depend on the results of the audit. Carry-back of unused exemptions requires at most the auditing of returns of taxpayers who at least were formerly above the exemption level; thorough administration of a carry-forward would require either the current auditing of large numbers of returns of taxpayers many of whom will never have income above the exemption level, or auditing the returns of those who do later develop taxable incomes, but then many years after the event, with the appropriate information having become difficult to obtain and unreliable.

It is uncertain to what extent EDP would make it more feasible to audit non-taxable, below-exemption-level returns on a scale sufficient to permit the unused exemptions to be carried forward. Wholly aside from the strictly EDP problems that this poses, there is the problem of what penalties would be appropriate and acceptable for misstatement of income on returns that involve no immediate tax consequences and may prove not to have tax consequences in the future, either. Moreover the desirable side effects that exist with carry-back are lacking with carry-forward: carry-forward diminishes the anti-inflationary effects of an income tax in damping excessive expenditure during a boom, and while carry-forward may ultimately ease the burden of those with an extended period of non-remunerative training at the beginning of their adult life, it provides no actual funds for the financing of this education. All of which raises the question as to whether one would want the carry-forward, even if EDP made it relatively easy to have a strong audit of all of these below-exemption-level returns.

Allowing carry-back but no carry-forward of unused exemptions can be put into effect in an extremely simple manner: potential negative entries in the adjusted cumulated income are suppressed and zero entered instead; zero entries will also be used, in effect, by those filing for the first time. There is, however, one further point at which EDP may play a significant role: to avoid arbitrary discriminations, it will in general be desirable to consider that all taxpayers begin their averaging period with, say, the year in which their 21st birthday falls. (Initially, the year of enactment of the averaging scheme, or, for the foreign-born, the year of immigration, if later, would be used.) For taxpayers reporting taxable income for the first time at say age thirty, and accordingly having a zero cumulated income carried forward, it might be necessary to check to see that this was in fact their first return and that they are not simply ignoring earlier income. To do

this job completely would require the compilation of a master file of all taxpayers, not an insuperable job with EDP, but possibly even so not worth while, given that the gain to the taxpayer from such concealment would in most cases be small or even negative unless he were over the first $2,000 rate bracket. Of course one must also consider the desirability of breaking this rate bracket down: it is rather absurd to see the married taxpayer with an income of $1,500 paying at the same marginal rate as the married taxpayer with an income of $5,000.

### *Other Forms of " Perennial Assessment "*

The above has been in terms of cumulative assessment, but the techniques can be applied over a much wider area. Many other tax assessment formulas can be thought of that make the current tax payment depend not only on current income, but on data representative of the past experience of the taxpayer; the defining characteristic of cumulative assessment is that the ultimate tax burden is made to be very nearly independent of the way in which income is allocated to different income periods, and it is this characteristic that makes it possible to relax, for example, controls over depreciation charges. Cumulative averaging is capable of application in ways that accomplish much more than mere " averaging "; for example, adjusting tax burdens appropriately between taxpayers who die relatively young and those who survive to an advanced age; between taxpayers who spend their entire adult lives in this country and those who immigrate or emigrate, and the like.

There are other forms of " perennial assessment " however, that may be less ambitious in scope, but perhaps easier to sell politically. In some cases, the administrative problems associated with such proposals are likely to be roughly the same as for cumulative assessment, but since the tax burden in these cases may depend on the allocation of income between time periods, administration must include a more rigorous check on accounting procedures and other factors that may operate to shift income between time periods. Nevertheless for the sake of completeness, some of these are mentioned here.

" Exponential " averaging is a system of averaging based on a series of weights that form a geometric series. The theoretical advantage is that the average is influenced more importantly by the current and immediately preceding years, so that the current income is not unduly influenced by incomes of years long in the past that are not felt to be as relevant to current taxpaying capacity as would be the more recent years; nevertheless there is no sharp cutoff between the years included in the average and the years excluded. The practical advantage is that the amount of record keeping and carrying forward of information is much less than is required by most of the superficially simpler " moving average " formulas. In exponential averaging, the average income for the current year is simply a weighted average of the income for the current year and the average income as reported for the preceding year. The weights can be fixed, or can be varied from year to year. If, for example, a fixed weight of 1/3 is attached to the income of the current year, the result approached after several transitional years will be a weighted average in which the current year is weighted 1/3, the preceding year 2/9ths, the second preceding

year 4/27ths, the third preceding year 8/81sts, the nth preceding year $1/3 \times (2/3)^n$, and so on. Of course, one difficulty is that if the tax is based directly on such an average income, two difficulties arise. A taxpayer may have to pay a high tax on an average income which is high because of incomes of years some time in the past, so that he may be short of funds with which to pay the tax. A second difficulty is that the total weight attached to incomes in the initial years of the scheme is likely to be greater than one, with the danger of an effective marginal rate greater than 100 per cent, while incomes of the later years are correspondingly "undertaxed." There is then an obvious advantage in shifting income out of years at the beginning of the scheme, where income is counted more than once, in the aggregate, to years near the end, when income is counted less than once, in the aggregate.

Both of these difficulties can be dealt with readily by the adoption of the Australian method: the tax *rate* is determined by this average income, but the rate so determined is applied to the current income. The mechanics of such a scheme could be handled in much the same way as one of the cumulative averaging methods, except for the fact that it would not be possible to be quite so lenient about the re-allocation of income between time periods through expensing, depreciation, and the like. The main advantage of this method would be that its rationale would be a little more transparent to the unsophisticated congressman or taxpayer than would that of cumulative averaging. In my own judgment, however, this is the only relative advantage of this type of averaging, and it is an advantage that I would consider to be vastly outweighed by the advantages that cumulative averaging offers in removing tax incentives for the shifting of the year of realization of income, and thus getting rid of the vast bulk of the special tax considerations that now exert a baneful pressure on practically every major financial transaction.

Distinct from the above averaging proposals, which are conceived of as being applied automatically and universally by substantially all taxpayers, are proposals for "averaging relief." Here the taxpayer who finds that he has been taxed unduly heavily because of fluctuating income can apply for relief; it is usually planned that only a relatively small number of taxpayers would thus apply, and only at relatively infrequent intervals. Auditing of such relief applications would require access to a file of past returns for the taxpayer, and it is in connection with such procedures that EDP procedures seem to have most to offer relative to an exclusively manual processing. Even with all the aid that EDP can provide, however, such "relief" types of averaging appear relatively unpromising compared with universal procedures: since the procedure is optional, a considerable burden is imposed on the taxpayer to determine whether he is eligible; and in some cases even to decide whether his interests are better served by waiting until a subsequent year when the relief would be even greater, rather than by an immediate application in the first year in which he is eligible, which might estop him from claiming greater benefits later on. This is particularly troublesome in that the greatest relative inequities from irregular incomes occur with incomes that fluctuate near the exemption level, and

taxpayers at this level are particularly unlikely to be prepared to make calculations and decisions of this nature. Such averaging relief is likely to add to the complication of an already overcomplicated tax law, without offering any of the possibilities for compensating simplification that are inherent in such methods as cumulative assessment.

Before leaving the subject of averaging, it is perhaps worth noting that the plans of the Commissioner of Internal Revenue, in connection with the introduction of EDP procedures, as announced in the annual report for 1959-60, already include the setting up of a consolidated tax account for each taxpayer which will permit a check of the status of his account to be made in each case before a refund check is issued; it would be only a minor addition to this account to include with it the three carry-forward-coupon items that will be all that is needed to carry out the cumulative assessment procedure. It appears altogether likely that the records associated with most of the other averaging methods would prove much bulkier and more difficult to incorporate in such a consolidated tax account.

### *EDP and the Small Income Taxpayer*

At the bottom end of the income scale, the pattern of the income tax law has been considerably distorted from what would probably be considered a theoretically ideal tax pattern by what, rightly or wrongly, have been considered to be the needs of administrative simplicity. The two major indications of that have been the insistence that all personal exemptions be expressed in integral multiples of $600, and the absurdly large $2,000 initial bracket, which might have been appropriate when the initial rate was on the order of 4 per cent, and the exemption for a married couple was $2,000, but now means that a married couple with an income of $1,500 is subject to the same 20 per cent marginal rate as a couple with a $5,000 income. Even assuming that a broad band of taxpayers should be made subject to a single marginal rate for the sake of facilitating withholding on a basis that will closely approximate the ultimate tax liability, it is still somewhat absurd that the rate differential at the low end of this broad band should be 20 per cent, while at the other end it is only 2 per cent.

While this situation does not appear to have serious ill effects, it is one that could well be adjusted. Such an adjustment might be facilitated by a willingness to perform a fairly complete overhaul of the withholding process in connection with the development of EDP procedures, though even this is not absolutely necessary. Since under the present system refunds of overwithholding are made on nearly 60 per cent of all individual income tax returns, and presumably on an even larger proportion of the small-income returns, adjustment of the rate schedule would seem to be possible without the increase in the disparity between tax withholding and ultimate liability becoming a serious problem. For example, from the point of view of equity, it would probably be rather desirable to substitute for the present schedule something like that shown in Table I. Such a schedule would have the desirable effect of reducing the tendency for marginal workers to limit their employment when they are in danger of going over the exemption limit and becoming subject to the present 20 per cent rate, in addition of

course to the various payroll taxes, where applicable.

In a similar vein, it would probably be desirable to adjust the personal exemptions to be more in line with the equities in the situation. Personal exemptions could well be made to vary according to the proportion of income that is earned, and to make special allowance for cases where husband and wife both work. In the same way exemptions for dependents could be brought more nearly in line with the realities of the typical situation.

These possibilities are particularly attractive in conjunction with cumulative assessment. Indeed, the British system of PAYE is essentially no different from cumulative assessment applied on a weekly basis over the taxable year, instead of on a yearly basis over the taxpayer's lifetime. The procedure is essentially for the Inland Revenue to furnish to the employer a schedule number for each employee; a table then gives, for each pay period of the year, and for each cumulative amount of pay for the year, the cumulated amount of withholding that should have been made; the employer can simply subtract the amount already withheld to get the amount to be withheld for the current pay period. With cumulative assessment, after the taxpayer has been in the system for a few years, the amount to be withheld from any taxpayer will be a linear function of his earnings over a very wide range of earnings; in effect, even though the tax brackets for one year are cut to only $500, after a taxpayer has been on cumulative assessment for say six years, income for the current year would be able to vary over a $3,000 range with the taxpayer still being subject to the same effective marginal rate.

TABLE I

| Surtax Net Income | | Present Schedule | | Suggested Schedule | |
|---|---|---|---|---|---|
| | | Cumulative Tax | Bracket Rate | Cumulative Tax | Bracket Rate |
| $ 0 to | $ 500 | $ 0 | 20% | $ 0 | 10% |
| 500 | 1,000 | 100 | 20 | 50 | 15 |
| 1,000 | 2,000 | 200 | 20 | 125 | 20 |
| 2,000 | 3,000 | 400 | 22 | 325 | 24 |
| 3,000 | 4,000 | 620 | 22 | 505 | 27 |
| 4,000 | 6,000 | 840 | 26 | 835 | 30 |
| 6,000 | 8,000 | 1,360 | 30 | 1,435 | 32 |
| 8,000 | 10,000 | 1,960 | 34 | 2,075 | 34 |

If withholding at the source is to be made to work smoothly in connection with such a more refined definition of ultimate liabilities, it may be necessary to use EDP facilities along lines suggested by the operation of the British PAYE system. Instead of having the withholding determined entirely autonomously on the basis of a certificate presented by the employee to his employer, we may want to develop a more sophisticated procedure in which parameters will be assigned to the employee by the Internal Revenue Service for this purpose, and withholding will then proceed in a manner that might produce even less over or under-withholding than the present system, in spite of more elaborate schedules.

What is possible, then, is for the Internal Revenue Service to furnish to the

employer, either directly or via the employee, a designation of an exemption amount and a marginal withholding rate, which the employer can then apply to the wages paid. It is not necessary to elaborate here the details of the procedure by which this might be done, but certainly the operation would lend itself admirably to the use of EDP methods, both by the IRS and the employer.

Withholding on dividends and interest is another problem that must be considered if we propose to introduce smoother graduation of the rates at the bottom of the scale; however, to the extent that taxpayers subject to these rates must actually file returns and pay a balance due or request refunds in any case, the seriousness of this factor is not too great. Some taxpayers will be withheld on at say a 20 per cent rate and through oversight neglect to report this income and thus fail to get the refund to which they are entitled, but on the whole this situation is much better for equity and for morale than that in which the taxpayer gains through his own negligence. There is, of course, the possibility that a taxpayer might claim more interest and dividend income than he in fact received, and thus obtain an excessive refund; to require all taxpayers having such income to file withholding certificates on such income along with their returns is likely to lead to a rather serious multiplication of paper work which EDP will help with somewhat, but will not solve. One might be prepared to dispense with the filing of these slips for those taxpayers subject to rates of 20 per cent or more, since they would have no motive for overstatement of their income from this source; even so since payors of interest and dividends would not be able to discriminate readily between those for whom slips are required and those not needing them, the burden of preparing withholding forms for all interest and dividend transactions is not inconsiderable, though capable of fairly thorough mechanization.

### *Insurance, Annuities, and Pensions*

The taxation of life insurance policies and related annuity and pension contracts is currently in a state of thorough disorganization and confusion. Partly because of the inherent complexities of the subject, partly because of the obfuscatory tactics of interested parties coupled with sentimental pleas on behalf of widows and orphans, and partly on grounds of the paper work required, much insurance is in effect a tax haven that has been only moderately abused primarily because of the overhead costs involved and the ready availability of other havens such as state and municipal bonds. There is no valid reason, however, why the investment aspects of life insurance should not be given tax treatment on a par with other forms of investment. It would be exaggerating to say that the advent of EDP makes any critical difference in the feasibility of such a treatment, but it may nevertheless be appropriate to seize the occasion to see whether the impetus provided by the aura of EDP cannot be of assistance in introducing order and rationality in this much confused area.

### *Expenditure Tax*

On the record, the advent of EDP should naturally lead to a revival of interest in the expenditure tax as a basic progressive tax instrument. John Stuart Mill was reconciled to accepting

the income tax as a second best substitute for an expenditures tax primarily because of what he felt to be the impossibility of administering an expenditure tax effectively. And even after Irving Fisher had shown how expenditure could be calculated, for tax purposes, by subtracting net investment from income, the lack of interest in such a tax has been due in large measure to doubts as to its administrability.

Such doubts may perhaps be abated somewhat by observing that an expenditure tax is, in effect, quite similar to an income tax with accelerated depreciation carried to its extreme by permitting all capital outlays to be written off immediately, for tax purposes. Of course, the logical corollary to the more extreme forms of accelerated depreciation is that any recovery through liquidation of capital of an amount in excess of the written down book value calls for the inclusion of this excess in gross income taxable in full; it is likely that the advocates of accelerated depreciation might not be so eager if it were not for the strong likelihood under the present law that accelerated depreciation would result directly or indirectly in the ultimate conversion of ordinary income into capital gains rather than the mere deferment of realization of income, or carryback of loss. Accelerated depreciation is usually proposed for application primarily to assets that will eventually become substantially worthless, rather than to assets that are expected to be resold, so that the amount of such excess recovery to be accounted for is relatively small. If all assets are allowed to be written off entirely at the time of purchase, then the number of cases in which the recovery must be accounted for will multiply, but this is the chief difference between administering accelerated depreciation and an expenditure tax.

Indeed, if we compare cumulative assessment of an income tax which allows immediate write-offs and cumulative assessment of an expenditure tax, the chief difference will be that with the latter gifts and bequests are accountable receipts for the beneficiary, and, under some interpretations of the concept are deductions for the donor; and of course that certain items of exempt income, such as municipal bond interest, would have to be brought into the account. Other than this, the main differences are that the interest factor would, in principle at least, be handled in a slightly different way so as to discount the expenditure of later years relative to earlier years, and as a purely formal matter the tax itself might be excluded from the base, but neither of these differences involve administrative considerations.

Perhaps the simplest way to administer such a tax would be to require the taxpayer to report, in addition to his income and gifts and bequests, his assets and liabilities, in terms of their taxable basis, at the end of the year. Expenditure is then computed as net worth as reported for the previous year, plus income, minus net worth reported at the end of the current year. In the absence of an expectation of substantial rate increases, and in any case if averaging is being applied, the incentive for the taxpayer would be in the direction of overstating rather than understating his end-of-year net worth. This is a favorable situation for enforcement, at least once the tax is well etablished, since it is rather more difficult to claim non-existent assets or conceal liabilities than to conceal assets or claim non-existent liabilities.

At best, however, an adequate check of this information would be moderately difficult, though possibly not seriously more so than the discovery of unreported income for income tax. If returns were required of all persons, natural and juridical, then conceivably cross-checking of the assets reported in the returns of the creditor against the liabilities reported in the returns of the debtors would yield a check. Variations in the spelling of names and other identifying data would of course produce considerable difficulty of a sort particularly difficult to handle mechanically. In many cases there would be legitimate differences in the values attached to the same item by the two parties, but on the whole this would not be too serious since the main purpose of the matching would be to reveal unreported liabilities and verify the genuineness of assets, establishment of the legitimacy of the value reported being more a matter of consistency on the records of the taxpayer, in most cases. If, as is likely, a complete matching of the items reported is impractical, even with EDP, it might still be possible to select for sorting and matching all items involving persons in certain arbitrarily defined alphabetical ranges, as a kind of random sample.

At any rate, for upper bracket taxpayers, the administration of an expenditure tax, aided by EDP, would seem to be well within the realm of feasibility, if not actually easier than administration of the present crippled and distorted income tax. And since the prospects for a genuine and thorough rectification of the inequities and inconsistencies of the income tax against the opposition of well-entrenched vested interests is beginning to seem increasingly remote, transformation of the income tax on upper bracket incomes into an expenditure tax seems well worth attempting, if only as a way of circumventing these difficulties, and the advent of EDP may well prove a strategic occasion for making this change.

*Succession Taxes*

The strong vested interests that have grown up around the present crediting provisions of the Federal estate tax make progress in the area of succession taxation extremely difficult. The smaller number of returns makes the advantages of EDP seem considerably less important than with income or expenditure taxes, but still not negligible.

Without being a decisive factor, the availability of EDP would certainly make such radical reforms as conversion to a cumulative accessions type of tax, or even to a bequeathing-power [1] method of assessment, relatively more attractive. The cumulative accessions form of tax is of course to be desired on the basis of conforming more nearly to the objective of promoting a more equal distribution of wealth; the bequeathing-power method has in addition the property of making the ultimate burden of the tax depend only on the ultimate distribution of inherited wealth and independent of the modes or channels of devolution selected by the taxpayers, thus removing much of the baneful influence of the tax structure in inducing unnecessarily complicated, rigid, and costly testamentary provisions.

The present system with its open invitation to almost complete avoidance is to this somewhat jaundiced eye almost beyond being capable of much im-

[1] See the writer's *Agenda for Progressive Taxation* (Ronald, 1947).

provement by the kind of tinkering that we are likely to get. The inclusion of gifts and bequests in the same cumulative progression would help a good deal, at least for the time being until taxpayer ingenuity adapts to this change. Given the small number of gift tax returns at present, the filing problem would not be serious even without EDP. Probably the main contribution of EDP here would be in the direction of lowering the exemptions and exclusions for the gift tax, but even with a substantial lowering, the problem is likely to be primarily one of obtaining adequate reporting, rather than of processing the data after they are obtained. One of the not inconsiderable advantages of an expenditure tax is that it would provide a good deal of the information needed at this point. By the same token, however, imposition of a stiff expenditures tax would probably make succession taxes seem less necessary, at least over the middle income ranges.

### *State and Local Taxes: The Property Tax*

Superficially, EDP would seem to have a great deal to offer to the improvement of the assessment of the real property tax, and indeed in some areas the process has been mechanized to a noteworthy degree. One can easily conjure up a scheme where all parcels are recorded on a master magnetic tape with a reasonably complete description of the property in terms of a fairly substantial number of parameters, where this master inventory is kept up to date through the compilation of a list of changes, and where price data from transactions are analyzed by fancy correlation techniques to provide an assessment formula for valuing this inventory, with the formula being itself revised at frequent intervals.

This raises the question of whether the real property tax as we conceive of it in principle is a sufficiently innocuous form of taxation to stand being assessed strictly in accordance with its theoretical principles. Many are convinced that the prompt assessment and taxation of improvements at full value would have a serious effect on urban redevelopment and other forms of property improvement, as is evidenced by the fact that plans will not go forward, in many cases, without some form of tax relief being applied. Delays in correcting assessments may indeed be a form of unofficial tax abatement that may in fact be badly needed; to guarantee prompt reassessment through EDP procedures might well do more harm than good.

To look at the matter optimistically, one might hope for reform of the property tax towards ultimately taxing land values more heavily, and taxing improvements primarily in relation to physical characteristics that relate to some form of social cost imposed upon the community rather than to the cost directly incurred by the owner. In terms of economic motivation, it is absurd to have two buildings, for example, located side by side and identical in terms of occupancy characteristics, but the one, being a more costly fireproof structure paying higher taxes than the neighboring firetrap. To be sure, one ought not to expect the property tax to perform the function of a building code, but on the other hand it is certainly undesirable to have a tax that enhances the incentives for violation or at least for mere minimal compliance with such codes.

Transition from what we have now to such a reformed property tax is likely to prove difficult, at best, particularly if an attempt is made to avoid undue disappointment of legitimately held expectations and infringement of vested positions established in good faith. There may be ways in which EDP could assist in the transition process through permitting more factors to be taken into consideration than can readily be handled by traditional methods.

## DISCUSSION NOTES

The discussion brought out what appears to be a danger attached to the use of EDP equipment and procedures. There may be a tendency to merely translate present practices and procedures to computer operation because of the machine capability to do a lot of things much more rapidly. This probably is not the best thing to do in the long run. EDP should relieve some of the administrative burden so that imaginative tax thinking is possible. With the application of simulation models to tax administration, imaginative and decisive tax thinking can be tested for taxpayer reactions. The limitations here are not limitations of the hardware, but rather the lack of imagination in the people using the machinery. It seemed as though EDP's policy implications were strongest in this respect.

Several different types of tax structures and " tax reforms " were discussed in terms of their implementation and enforcement through the use of EDP techniques. Some of these were:

1. The averaging concept developed in the paper.
2. An expenditures tax as an alternative to the income tax.
3. The state-federal problems in the field of survivors and inheritance taxes.
4. The property tax.

Discussion then returned to two earlier points.

1. Whether the taxpayer should continue to have to do any computing of his own tax.
2. With respect to integration, there was an expressed opinion that EDP might enable reforms to be obtained indirectly which would not be available directly. As an example, if both income taxes and social security are each administered with EDP, the duplication will then be more apparent and soon somebody will suggest that the processes be combined.

EDP was not seen as having much potential in the gift and estate tax areas where all suggested reforms are not sufficiently mathematically sophisticated to demand EDP for acceptance.

In terms of the cross-reference of data that " should " be available in the Master File, EDP procedures have much to offer

in fostering greater integration between various taxing bodies. This was not limited to state-federal integration, but included the various local taxing bodies such as cities, townships, counties and school districts. The capabilities of the equipment are known. What is required is a re-thinking of the problems of tax policy in terms of socially desirable goals. Once the problem has been defined and alternative choices explored, then the machines can be adapted to fit the requirements of the solution. As automation increases, the whole social structure of our environment will be subject to revolutionary change; tax administration must keep abreast of this change.

# SIMULATION AND TAX ANALYSIS: A RESEARCH PROPOSAL †

WILBUR A. STEGER *

MORE than thirty professional economists submitted testimony in the recent hearings of the U. S. House of Representatives Committee on Ways and Means, conducted to investigate the possibilities for constructive tax reform.[1] While the essential worth of these testimonies must lie with the members of the Committee, an " objective " overview of these efforts would have to include the following observations. First of all, it is striking to note that " equity " arguments are used time and again to support specific policy conclusions which, themselves, are not based on rigorous analyses or empirical evidence. Secondly, not only are the non-economist members of the panel frequently in strong disagreement, but two or more economists will also reach diametrically opposing conclusions.[2] By and of itself, this is perhaps the nature of normative, policy-seeking economics, seeking as it does to " clarify the issues and choices concerning the allocation of revenues which are, or ought to be, the subject of national political debate." [3] Nevertheless, if a way to settle these differences could be found, most would be in favor of seeking it out.

Unfortunately, this paper has no such cure-all to recommend; but it *does* make a proposal which could, at a minimum, improve the situation and change the many reasons for the " differences of opinion " to more empirically debatable proportions. To forestall any sharp feeling of let-down on the reader's part, I must warn him that this proposal is merely the result of putting together some of the newer " management science " and econometric techniques — such as simulation, heuristic decision rules, and computer technology—with a spelling out of the implications of detailed alterations in the tax law.

Before this " plan " is described, a short discussion of the reasons underlying the " disagreement among experts " is in order. As a case in point, an example is drawn from the pages of this

† The material in this paper is an integration of work done before coming to RAND and experience at RAND with applying simulation techniques to military problems. The RAND Corporation provided clerical support.

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1 *Tax Revision Compendium*, submitted to the Committee on Ways and Means, U. S. Government Printing Office, Washington, D. C., 1959.

EDITOR'S NOTE: This paper, as noted in the Foreword, was not presented at the Conference but was obtained independently.

2 For a discussion of " tax experts " and federal tax policy, see R. Blough, *The Federal Taxing Process*, Prentice-Hall, New York, 1952, particularly pp. 125-145.

3 F. M. Bator, *On the Uses of Economics: Theory, Policy, and Values*, The RAND Corporation, Paper P-2174, February 9, 1961.

Journal, followed by a brief description of some recent additions to the economic analyst's tool kit and how they might be applied to the problem at hand. While portions of the proposed simulation model already exist, the purpose in describing it below is primarily to indicate how some of these newer techniques *might aid* in the formulation of tax policy: if the idea has merit, the particular method of application — something like that described in these pages—will then be chosen. As a last warning: much of what follows is hortatory, unproven, and untried. The originality, if any, is in the particular way some loose threads have been pulled together.

## SOME CAUSES OF DISAGREEMENT AMONG EXPERTS: THE EXAMPLE OF CAPITAL GAINS TAX PROPOSALS

Alternative capital gains proposals were among the more heatedly debated topics before the Committee,[4] but a more concise example of differences among very able public finance theorists is that among Harold Somers, Walter Heller, and Robert F. Gemmill, discussed by Somers in a recent *National Tax Journal* article.[5] That such differences arise is not unusual since, in Blough's words, " tax analysis is necessarily in terms of tendencies and probabilities, for unseeable factors extraneous to the tax may upset all calculations." [6] In this spirit, the purpose of the following discussion is to classify briefly the reasons for the differences through an example, which in turn will be used to evaluate how the research proposal discussed below may offer aid in some of these areas.[7] The following are the principal reasons for these disagreements:

(1) Differences in system objectives;
(2) Scope of the analysis;
(3) Actions of the rational investor;
(4) Lack of empirical data; and
(5) The dynamic interrelationships involved.

### *Differences in System Objectives*

Economists may differ on specific system goals when discussing any but the grossest economic aims. No harm is done so long as these are listed as a specified set of values, since the economist can then state and evaluate the alternative modes of obtaining these values. Somers very clearly states, for example, that one of his objections to the present capital gains structure is that it is *undesirable* to prevent a stock-market correction in an upswing through the artificiality of a tax lock-in effect.[8] Similarly, where tax effects prevent otherwise economically wise investment decisions, this is clearly *undesirable* from the standpoint of economic growth.[9] Part of the reason that Heller disagrees with Somers' critical evaluation of the present capital gains structure is that he does not believe these are necessarily unmitigated evils. For example, Heller believes it may be *desirable* to maintain the stability of security prices in an upswing through the " lock-in " effect of the capital gains tax.[10] Here, when experts

4 See *Tax Revision Compendium*, pp. 1193-1299.

5 Harold M. Somers, " Reconsideration of the Capital Gains Tax," *National Tax Journal*, December, 1960, pp. 289-309.

6 Blough, *op. cit.*, p. 129.

7 In other words, no attempt will be made to judge the " correctness " of the arguments made on both sides—*both* of which, incidentally, I found most persuasive and cogent.

8 Somers, *op. cit.*, pp. 298-299.

9 *Ibid.*, pp. 302-303.

10 W. W. Heller, " Investors' Decisions, Equity, and the Capital Gains Tax," *Federal Tax Policy for*

differ for this reason, the tax policy maker has to match his own choice of objectives with those of the tax experts. In fact, the economist's calling attention to these alternative goals may aid the policy maker by expanding his knowledge of the possible effects of his decision. Definition and agreement to explicit criteria, then, is the first need for agreement among tax experts. The remaining causes of differences among experts involve more technical considerations regarding the methods of the analysis.

### *Scope of the Analysis*

Economic analysis requires the stipulation of a particular abstraction of the material world deemed to incorporate the relevant features. Furthermore, these features, when manipulated, purport to reflect valid conclusions about the real world. Thus, it is not surprising to find that, in as complex a situation as people behaving under alternative tax structures, analysts have decided to " partition " different parts of the world in different ways for intensive study. One analyst of the impact of capital gains on asset prices, for example, has chosen to ignore specified but related portions of the tax structure (such as the provision of the tax law permitting an investor to avoid paying accrued capital gains at death, or the differential tax rate/holding period provision) and makes highly simplified assumptions about investors' expectations and the number of assets involved (for example, a " single asset " is used in much of the analysis).[11] However, Somers refuses to operate under the same ground rules—his distinct privilege, since no one knows precisely how to set the workable boundaries of a " predictive " economic analysis. Somers reiterates the validity of an effect that Gemmill has disputed, merely by restoring to the analysis the related portions of the tax law omitted by Gemmill.[12] At the same time, Somers expands the scope of his original analysis [13] by including some additions of Gemmill's: the capital and liquidity effects of the capital gains tax.[14] These factors, it is admitted, partially offset the effect postulated originally in their absence. The moral, of course, is that it is necessary to include all factors which bear upon the analysis in question, and to expand the numbers of these explanatory variables when necessary; more about this below.

### *Actions of the " Rational Investor "*

Allied to this " scope " question are the postulated actions of the so-called " rational investor." For example, he is expected to behave differently when he is alleged to have a desire for liquidity or to be aware of the possibility of escaping the capital gains tax forever on his deathbed. But even where these tax analysts admit to the same *scope* for the hypothetical investor's " decision factors," they have different opinions about the investor's actual behavior. Heller contends that rational behavior precludes taxes from affecting the sophisticated investor's decision processes; [15] Somers

*Economic Growth and Stability*, 84th Cong., 1st sess. Joint Committee on the Economic Report, 1955, U. S. Government Printing Office, Washington, D. C., 1956, p. 388.

[11] R. F. Gemmill, " The Effect of the Capital Gains Tax on Asset Prices," *National Tax Journal*, December, 1956, pp. 289-301.

[12] Somers, *op. cit.*, p. 296.

[13] *Idem*, " An Economic Analysis of the Capital Gains Tax," *National Tax Journal*, September, 1948, pp. 226-232.

[14] Gemmill, " The Effect of the Capital Gains Tax," p. 299.

[15] Heller, *op. cit.*, p. 386.

disagrees, arguing that taxes are one of the factors the rational seller always considers; [16] and Gemmill holds that a rational investor will *not* increase his reservation price sufficiently to cover the *full* tax liability at the sale price. The issue is important because if, in the simplest cases, sales which would have been profitable in the absence of a capital gains tax become unprofitable with it, then the capital gains tax can be held responsible for increasing stock prices " artificially." Gemmill admits this *can* happen, but demonstrates that an investor will not demand the entire amount if he can sell and take advantage of an expected decline in the price of the stock.[17] Going beyond Gemmill's analysis, it is easy enough to show that, by allowing the investor to benefit by selling the stock short prior to its decline—even if he has to obtain funds by selling the appreciated asset prior to its decline —it would *always* pay to sell short and then buy back at the anticipated low.[18] This is more in conformance with Heller's stated beliefs but does not mean that tax factors are entirely ignored, even here: the capital gains tax on the appreciation of the first sale and the gain on the short sale *do* decrease the potential gain relative to what it would be without the capital gains tax. Thus, where enough uncertainty exists, the investor may not wish to incur the certain tax for only a probable larger total gain. My primary reason for bringing in the real-world complications of short-selling, at this juncture, is not to add to the dispute between Gemmill and Somers; rather, it is to show how difficult it is to define unambiguously the " rational investor's " actions in the face of such complications as differential holding periods, short-selling, puts and calls,[19] many stocks undergoing various price trends, different liquidity preferences, shifting time-discount factors and margins, etc. No one doubts the empirical evidence that capital gains taxes have a significant impact on investors' behavior; [20] but even these empirical studies indicate that taxes have had a differential impact, not entirely predictable, on various groups in the population. No theory has yet explained all the empirical evidence on the subject and perhaps none ever will. Except for those who may fall under the broadest (and nonoperational) definition of the " rational investor," most investors probably do not act as " rationally " as tax experts claim they do. The importance of this fact lies beyond the disagreements it causes among experts, and we shall return to it later.

### *The Lack of Empirical Data*

Few facts of economic life are so pervasive as the several aspects of the income tax; yet we are forced to perform a great deal of " guesstimating " in attempting to describe the actual past performance of individual investors of various types in the face of changing

[16] Somers, " Reconsideration of the Capital Gains Tax," p. 294.

[17] Gemmill, *op. cit.*, p. 294.

[18] The reader will be spared the algebraic proof of this easily derived fact. He can demonstrate it to himself by using Gemmill's example (*ibid.*) and postulating various potential price appreciations much greater than Gemmill's postulated $270.

[19] See C. B. Franklin and M. A. Colbey, " Puts and Calls: A Factual Survey," *Journal of Finance*, March, 1958, pp. 21-34.

[20] L. H. Seltzer, *The Nature and Tax Treatment of Capital Gains and Losses*, National Bureau of Economic Research, New York, 1951, p. 178; J. K. Butters, L. E. Thompson, and L. J. Bollinger, *Effects of Taxation: Investments by Individuals*, Harvard Graduate School of Business Administration, Boston, 1953, pp. 29-32.

times and tax laws. Here, our problem is not merely to predict " rational " behavior; it is to interpret relevant *past* behavior. No amount of *aggregative* data, such as are usually produced for tax analysis, can help quantify, for example, just how many of Somers' individual demanders will " walk- " (rather than " flock-") in because of the effect of the capital gains tax.[21] Nor has anyone attempted to assign numerical magnitudes to such behavior. As with the preceding two categories of reasons for disagreement, we shall return to this topic as well.

### *The Dynamic Interrelationships Involved*

Finally, and perhaps as a subtopic under the immediately preceding one, there are questions involving the relationships among agreed-upon variables. Perhaps they are basically data questions, because no one may doubt that (for example) " suppliers " may also become " demanders " and vice versa.[22] However, how *many* demanders become suppliers, and how soon, *is* still a basic question which helps determine the net cash position of all investors (vis-a-vis the market) and therefore the trend of market prices. As of now, we have very little information about these sorts of dynamic interrelationships.

The above listing by no means exhausts the reasons for disagreements among tax experts. Blough, for example, includes among other reasons: incompetent analyses, different personal experience of the experts involved, or lack of objectivity on the part of one or more of the experts.[23] None of these reasons are present in the current example, but even they will be dealt with, to an extent, by the technique proposed in this paper.

## THE NEW TECHNIQUES

Management science, operations research, mathematical economics—many claims have been made for the power of these techniques, including statements that a judicious selection of many tools from this grab-bag will finally enable us to apply to economic questions the same " scientific method " used in the physical sciences. Experimentation, ordinarily forbidden to the economist for obvious reasons, is permitted in a vicarious manner. This, it is claimed, allows the confrontation—as in the physical sciences—of hypotheses generated by the accumulation of experience.[24]

### *Simulation in General*

Several elements unite to produce the particular configuration of these newer techniques which I believe will yield the greatest worth in the specific area of public finance, the evaluation of alternative income tax proposals. The overall technique is called " simulation ". Most dictionaries define " simulate " as, " to assume or to have the mere appearance or form of, without the reality." In place of so unflattering a definition, it is not surprising to find simulation increasingly referred to as " a general approach to the study and use of models," [25] or a technique for " building theories that reproduce part or all the output of a behaving system." [26] For

21 Somers, " Reconsideration of the Capital Gains Tax," p. 308.

22 *Ibid.*, p. 297.

23 Blough, *op. cit.*, p. 139.

24 G. H. Orcutt, " Simulation of Economic Systems," *American Economic Review*, December, 1960, pp. 893-907.

25 *Ibid.*, p. 893.

our purposes, it is best to consider it as a laboratory investigation which reproduces the main features of a system for the purpose of specific analysis, without duplicating it in every detail.[27] Without attaching too much rigidity to our definition, we may say that " simulation " (a) is ordinarily placed in contradistinction to conventional mathematical techniques, (b) intensively uses electronic data processing equipment to perform its mathematical tasks, (c) " more realistically " includes considerable detail and large numbers of endogenous variables, and (d) produces as outputs time paths of these endogenous variables, as a product of a set of initially specified conditions and parameters. Much has recently been published about this relatively new (at least, for economics) analytic tool.[28] Much, perhaps, has been published in an unfortunately hortatory style, exalting the alleged virtues of the many manifestations of the technique. Briefly, it is purported to do the following better than more conventional mathematical devices can:

(1) Permit the study of large numbers of variables and relationships which current rigorous mathematical analysis finds impossible;

(2) Permit sensitivity test analyses of models;

(3) Serve as a data-organizing device;

(4) Serve as a planning tool;

(5) Prove to be more easily modifiable with the accumulation of learning;

(6) Assist in short- or long-run predictions of both microeconomic and macroeconomic units;

(7) Permit the identification of the important parameters and relationships in a specified problem; and

(8) Serve as a testing device for " preferred " policies suggested by other techniques.

*Simulation—In Particular*

One of the nation's largest simulation efforts[29] consists of a simulation activity designed to help military planners choose among difficult resource-allocation alternatives *at a level of detail* at which these decisions had to be made. Furthermore, senior military personnel " operated " and helped derive preferred policies through active participation in manned simulation models. If the technique is used properly, it can produce many of the advantages claimed for it in the preceding paragraph.

The simulation technique now exists in many forms. The RAND laboratory employs several, as well as more analytic techniques. In each of these forms simulation can be viewed as " an intermediate step between observation of the real-world and a complete mathematical representation of the real-world." [30]

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[26] G. P. E. Clarkson and H. A. Simon, " Simulation of Individual and Group Behavior," *American Economic Review*, December, 1960, p. 920.

[27] In this unusual sense, it has thus been referred to as " synthetic experimentation."

[28] H. A. Simon, " Theories of Decision-Making in Economics," *American Economic Review*, June, 1959, pp. 253-283; Orcutt, *op. cit.;* M. Shubik, " Simulation of the Industry and the Firm," *American Economic Review*, December, 1960, pp. 908-919, (especially his bibliographies on simulation, p. 919). For an allied topic, see the review article on management games, K. J. Cohen and E. Rhenman, " Role of Management Games in Education and Research," *Management Science*, January, 1961, pp. 131-166.

[29] The RAND Corporation's Logistics Systems Laboratory. For a description of some of its operations and results, see W. W. Haythorn, " The Use of Simulation in Logistics Policy Research," in *Sequential Decisions and Simulation*, Rosentiehl and Ghouila-Houri (eds.), Dunod, Paris, 1960.

[30] *Ibid.*, p. 214.

The primary choices in constructing the model to be used in a simulation study revolve around several alternatives, totally under the control of the experimenter. Depending upon the specific alternatives chosen, the resulting product may be either a highly detailed piece of hardware, such as a simulation link trainer for aircraft, or a very abstract all-computer representation of reality referred to as a " Monte Carlo " model. In the next section, the particular needs (the " demand side ") of tax-policy evaluation will be reviewed in the light of the kinds of benefits (the " supply side ") that simulation purports to yield. Following that, an actual simulated study will be suggested. However, anyone with previous model-building experience could very well decide that a different set of modelling choices should be made vis-a-vis tax-policy simulations. Regardless of the specific techniques chosen below, however, it is important to note that the ways in which these technical choices are made vitally affect the *cost* of the simulation effort and its chances of success.

A list of such technical choices, with some examples, includes:

(1) The scope—the particular functions, organizations, and decision-rules to be incorporated in the simulation model.

(2) The level of detail—the item-by-item particulars of each of the *included* functions, organizations, and decision-rules.

(3) The role and type of computer—during preparation; the simulation run (or " playing "); and the analysis phase.

(4) The presence or absence of participants within the model and their role—as decision-makers; clerical aides; evaluators of the model's internal validity; users of information; and definers of the rational (or irrational) role of the human in a complex system.

(5) The extent to which reality is simulated. The larger the role of the computer, the less the need for realism—so much so that in all-computer Monte Carlo studies, distortions of reality are intentionally introduced for experimental design purposes.

(6) Types of uncertainty present—the use of expected values; incorporating known variances as stochastic (probabilistic) elements; the presence of hostile opponents, as in a " two-side war-game."

(7) Experimental design—length of individual runs; number of runs; which parameters to vary and by how much.

(8) Collection of input data—using only available data; " plugging up " small known gaps; instituting a large data-search effort; artificially " manufacturing " needed micro-unit data from macro-unit data; or relying only on " manufactured " data but playing these through the model to see their effects.

(9) Miscellaneous technical considerations[31]—" one-period change " versus " process " (i.e., multi-period lags for the model's endogenously produced variables) models; recursive (proceeding in short, discrete time-period steps) versus " interdependent " (i.e., requiring in each time period the solution of a set of simultaneous equations); determining the calendar length of the basic time period chosen for the model.

This is only a partial list of the choices

[31] These are not meant to be belittled; their importance is great. However, in the interest of retaining the primarily non-technical character of this paper, I will merely refer the interested reader to Orcutt, *op. cit.*, and J. S. Duesenberry, O. Eckstein, and G. Froman, " A Simulation of the United States Economy in Recession," *Econometrica*, October, 1960, pp. 749-810.

open to the simulation designer, but it should reveal the sorts of problems confronting him. Basically, they are no different from those applicable to any other form of research, but they need to be made more explicit in a simulation experiment.

### WHAT FORM OF SIMULATION FOR TAX POLICY ANALYSIS?

We can now match up the *difficulties* of tax policy making (see above, p. 3) and a general *form* of the technique. Proceeding from the above-listed reasons for differences of opinion among tax experts (pp. 3-8), I have made a preliminary estimate of what a simulation to aid in the analysis of detailed tax proposals might look like. The particular form the simulation activity used in this comparison can be referred to as a " developmental, abstract, system-simulation of interacting taxpaying units." This form was chosen in the light of our very limited knowledge about the behavior of individuals and groups in the face of alternative tax policies; however, as we shall see below, other forms of analysis could also be used at various stages of the study.

Briefly, the proposed simulation exercise [32] would be (a) " developmental," in that some of the subsidiary models making up the over-all simulation model would be relatively ill-defined and ill-structured. The simulation exercise is partly used in an exploratory way to help better define the behavioral properties of these models and their over-all validity. It would be (b) " abstract," in that many parts of the model would be too costly, complex, or unwieldy to do anything but build a symbolic laboratory representation, probably through the use of a computer where the parts of the system are well understood. The exercise would comprise (c) a " system," in that the over-all model would include the relevant elements (i.e., those purported to affect the tax proposals under study) as are deemed necessary to achieve adequate representation. And (d) the exercise would embrace " interacting taxpaying units," in that individual decision-making " tax-units " would be represented in some realistic manner, interacting with one another and with relevant organizations in a complex, dynamic manner. The primary purpose of the model would be to learn about the behavior of different types of tax-affected " households " or " units " under varying economic and tax-policy conditions, so that the behavior of the *aggregate* tax-affected population can be better predicted in the face of alternative tax proposals. To do this, we computerize the more routine, predictable portions of the system through determinate or Monte Carlo models; we represent those portions which involve human judgment or inductive decision-making under uncertainty either by a human participant " embedded " in a simulated environment or by the mechanical simulation of the decision process itself.

### THE COMPONENTS AND RELATIONSHIPS OF THE SIMULATION MODEL

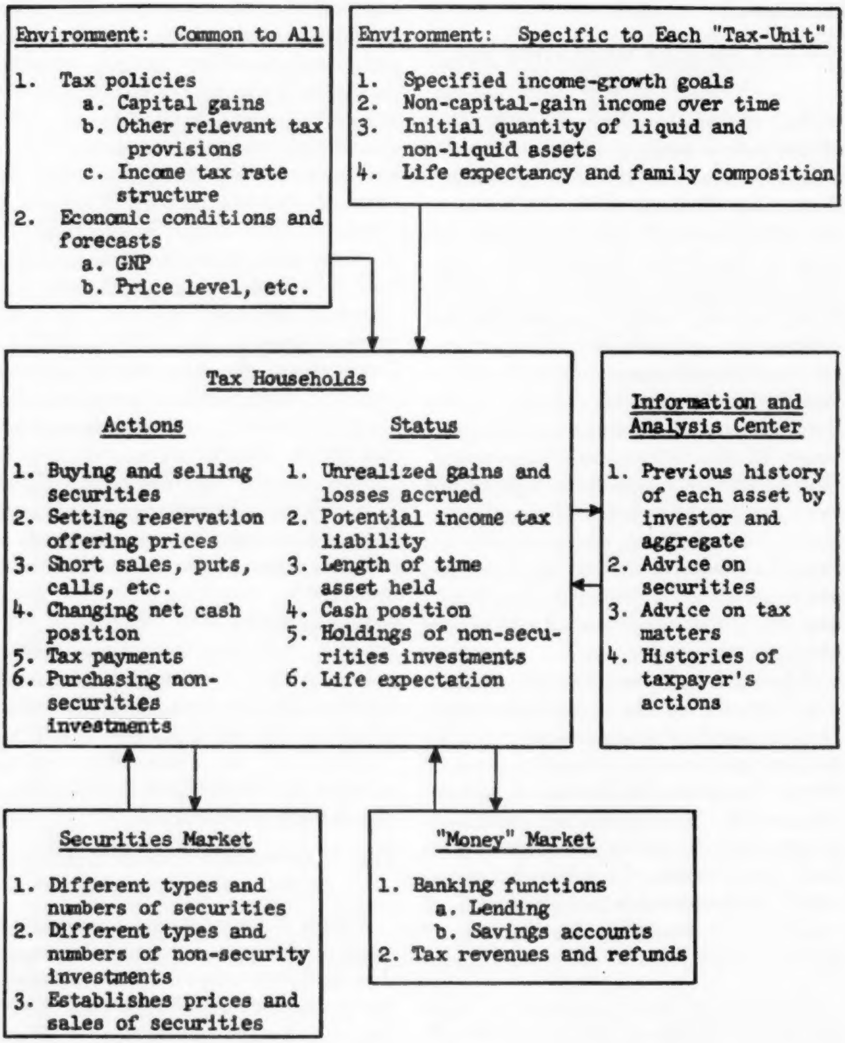
Figure 1 demonstrates the basic features of the proposed simulation model. The model's concept is by no means new, having been exercised in several RAND Logistics Systems Laboratory [33] simulations and presently being used in efforts

[32] This refers to the combined activity of collecting the necessary data, delineating the scope of the phenomena to be represented, building a computer model, and analyzing the results of variations in that model's initial conditions and other inputs.

[33] Haythorn, *op. cit.*

FIGURE 1

Simulation Model to Examine the Effects of Alternative Capital Gains Tax Policy Proposals



such as the simulation of the U.S. economy by Orcutt and his collaborators.[34] It consists of several types of " representative " interacting tax-households which (a) receive input information which alters their present status and cumulative history, and (b) operate upon the information to make decisions relative to a set of potential actions. These actions include buying and selling securities or non-securities investments, perhaps taking a different net cash position than previously, guided by any pertinent detailed tax considerations. The outputs from the operations of these tax households or operating units are, themselves, a function of several characteristics. Some of these characteristics are peculiar to that operational unit—its personal history in the securities and non-securities market, its income/growth objectives, and certain tax-relevant family characteristics. Others are common to all operating units, such as existing national tax policies (for e.g., capital gains and regular income tax rates, differential holding periods, realization criteria, the tax-savings from municipal securities, etc.), and economic conditions and forecasts. The operating tax units will individually interact with a securities market-mechanism model and a " money " (and tax) market-mechanism model. They will be able to obtain specified historical information and advice about securities and tax matters. The model's operation proceeds in discrete steps of relatively short time intervals [35] (i.e., it is a " recursive " operation), each period beginning with the inputs primarily generated endogenously from the previous period's operation of the securities and money market models. The operators receive these inputs as information and use it to make the current period's decisions. The results of these decisions are then fed into the securities and market operations models to create this period's security and non-security sales and prices, and the results of this period's banking functions (lending and aggregate savings changes).

The aggregative outputs of the study—the results of the interrelationships of the taxpaying units' individual outputs—are: the time series showing, for each security and non-securities asset, the period-by-period sales and prices; the liquidity position of the investors; the realized and unrealized capital gains and losses; the revenues from the income tax, with its sources identified.

Several features of such a model are the result of choices made by the simulation designer. These choices will be discussed under the following subject headings: (1) size of the experiment, (2) representation of the tax household's decision-process, (3) representation of the market mechanism, and (4) input sources.

### *Size of the Experiment*

The limiting factors here, of course, are professional and clerical resources and computer availability; prohibitive costs would demolish the advantage claimed for such a simulation.[36] Experience with the RAND simulations reveals that such a model, involving relatively few representative decision-making operating tax-unit types—say,

[34] Orcutt, *op. cit.*

[35] For many purposes, the model might be operated over very short time periods, such as days. However, it can be made sufficiently flexible to permit variable time-period length.

[36] For a discussion of methods to reduce the costs of the computer portion of such simulation experiments, see Orcutt, *op. cit.*, pp. 901-903.

up to ten—could operate with at least one hundred different types of securities and a similar number of non-security types of investments.[37] Of course, there could be large numbers of units within each type category.[38] Other limiting factors are, as we shall see below: the mode used to simulate the investor's decision-process, be it computer or human; the limitations of experimental design (see p. 298); and the sources of input data (see p. 299). One cannot precisely define the detail before other questions are also answered. In any case, the larger the number of types of securities and/or operating tax-units, the greater is the simulation's realism and our assurance of valid results; however, the simulation's costs and complexity increase accordingly.

### *Representation of the Tax Unit's Decision Processes*

For many purposes, it is not important that the internal mechanism of a simulation only superficially resembles the " real thing " being modelled, particularly where one can use all-computer Monte Carlo models.[39] But, since the primary object of the experiment is to promote better understanding of the effects of detailed tax policy on individual tax-paying units (and ultimately on the aggregative effect of such actions), we are more anxious to *predict* how these units will act under various stipulated conditions. If we understood the process of investment decision-making well enough, we could represent it in our model by a simple computerized " black box " which would receive inputs and generate the required outputs in a realistic manner. But no such " black box " mechanism exists today to reflect the non-linearities, the human-introduced errors, and the complexity of human-oriented goals or drives.[40] We have very few (if any) analytic, normative models which predict man's behavior accurately. Our choices, under these circumstances, become limited to the following:

(a) Careful observation of different types of investors, in actual market situations, relative to tax situations.[41] This method's primary limitation for the purposes of modelling taxpaying-units lies in its lack of detailed predictability of behavioral actions with respect to specified differences in tax and environmental conditions.

(b) Using humans as decision-makers. In RAND's manned simulations or games, two types of playing personnel have been used (aside from the conventionally used " college sophomores "): those who were known experts in their fields,[42] or the everyday practising, ex-

[37] A similar scope, in terms of the number of securities, has been used in simulating a selection of a portfolio of groups of securities. See G. P. Clarkson and A. H. Metzler, " Portfolio Selection: A Heuristic Approach," *Journal of Finance*, December, 1960, pp. 465-480.

[38] In a simpler simulation model than the one proposed here, several thousand tax-paying units were used. See W. A. Steger, " Averaging Income for Tax Purposes: A Statistical Study," *National Tax Journal*, June, 1956, pp. 97-114.

[39] A. W. Marshall, " Experimentation by Simulation and Monte Carlo," The RAND Corporation, Paper P-1174, January 28, 1958.

[40] M. Haire, " Psychology and the Study of Business," in *Social Science Research on Business: Product and Potential*, R. A. Dahl *et al.*, Columbia University Press, New York, 1959, p. 71, discusses how human-introduced error often leads to a very poor prediction of system performance. Others have described how man does not behave in simple binary-choice experiments as statistical decision theory would have them behave. See H. A. Simon, " Theories of Decision-Making in Economics," *op. cit.*

[41] Butters *et al.*, *op. cit.*, is an excellent study of this type.

perienced individual.[43] Differences in behavior will sometimes arise between these two types of manned-simulation participants, with the former often resorting to more elaborate analytic techniques to aid in decision-making. However, the everyday experienced individual sometimes has outperformed the "expert." In either case, even in the most complex system simulations, experience has shown that relatively few people (a maximum of six) are needed in any one decision-making "position" for representative behavior to be reflected. Of course, there are many advantages and disadvantages to introducing humans into a simulation: while they are fairly easily "reprogrammable" and help the experimenter learn and improve the formulation of decision rules, the use of humans tends to reduce the number of simulation sensitivity-tests one can make with a given model for a given analysis budget.[44]

(c) As an alternative to using humans, once it is possible to describe unambiguously the operating rules of the decision-maker for each set of information available to him—including the possibility of seeking further information—it is possible to specify a set of "heuristics" for computer simulation. "Heuristic" decision-making employs that kind of ". . . reasoning not regarded as final and strict, but as provisional and plausible only, where our purposes are to discover the solution of the present problem."[45] Even though the human faced with complex and uncertain situations may not have the memory, computing capacity, and rigorous set of algorithms belonging to a programmed electronic calculator using a set of economic rules, computer programs *simulating* the step-by-step thought of a human are beginning to approach predictive capability.[46] The primary future of these programs is that they perform some of the kinds of non-numerical computations and pattern interpretation that humans call "thinking." One of the more complex of such all-computer simulations has been that of a trust investment officer choosing securities for portfolio purposes.[47] The experimenters' conclusion is that their program is the beginning of a "descriptive theory of portfolio selection . . . to serve either as a predictor of investor behavior or as the basis for a theory of optimal portfolio selection."[48] The complexities of the income tax laws do not yet play an important part in this heuristic simulation, nor do goals of different investors, such as growth or income or some specified mixture of the two; however, those working in the field are confident of their future capability to introduce such complexity.[49]

(d) As a final approach, the decision-making process of our "tax-households" could be completely programmed for an electronic computer following the rules set down by H. Markowitz for the "rational investor." This is one who determines which "efficient set" of securities—i.e., one providing the maximum return for a given variance—con-

[42] Olaf Helmer and N. H. Rescher, *On the Epistemology of the Inexact Sciences*, The RAND Corporation, Report R-353 (ASTIA No. AD 236439), February, 1960.

[43] Haythorn, *op. cit.*

[44] Compression of time into artificially short simulated time periods can be done at least hundreds of times faster in unmanned simulations.

[45] G. Polya, *How to Solve It*, Princeton University Press, Princeton, N. J., 1948, p. 102.

[46] Clarkson and Simons, *op. cit.*; Clarkson and Metzler, *op. cit.*

[47] *Ibid.*

[48] *Ibid.*, p. 479.

[49] Simons, *op. cit.*

forms with his "multi-time" period utility function in terms of income stability and growth potential.[50] Markowitz develops a mathematical model and a computer program which can perform this service, at any interval desired, for individual investors. While not in the original program, modifications can be made to accommodate consumer durables and certain illiquidities; however, Markowitz states that, in his current formulation, he cannot calculate exactly the manner by which the portfolio should be modified to account for the capital gains provision.[51] Moreover, Markowitz does not claim that his formulation corresponds to the ways that investors actually behave, which is important for the purposes of the simulation study proposed here. Nevertheless, the Markowitz formulation can undoubtedly be modified to incorporate a "rational investor's behavior" with respect to the income tax laws and procedures: these may actually be the result of experiments such as those involving humans, or computers simulating humans.[52]

All of these are methods for better understanding the behavior of individual decision-makers. The necessity arises because it is perhaps the only technique which permits us to describe the individual's behavior and, then, the aggregate of the relationships among these individuals. The decision to choose (b), (c), or (d) as the primary model for Fig. 1, and (a), (b), or (c) to learn empirically about how individuals *actually* make decisions, is a matter of personal preference and research costs. In general, I favor proceeding through *each* of the steps from (a) through (d) and then choosing either (c) or (d) for its ultimate predictive value and computer-consuming time for eventual all-computer modelling.

*Representation of the Market Mechanism*

The job of combining the individual decision-maker's actions—or lack of action—into sales and purchases, price fluctuations, over-all price-level changing, etc., is the responsibility of the modelled market-mechanism. Recent developments in econometrics permit the study of the stability of market prices when there are interrelated actions over time and few buyers and sellers; [53] under certain conditions, it has been shown to be a stable condition even when there are many economic units.[54] Reiter has shown that market equilibrium can also result even in relatively unorganized markets where individuals have only limited capacities to communicate and obtain information on which to form expectations.[55] Interestingly enough, these studies show how the equilibrium of the *aggregate* market—market demand equalling market supply, the equality of individual asking prices, etc.—does *not* depend on the

[50] H. Markowitz, Portfolio Selection: *Efficient Diversification of Investments,* Cowles Foundation, Yale University Press, New Haven, Conn., 1959.

[51] *Ibid.*, p. 302.

[52] Furthermore, advances are being made at RAND in the quadratic programming techniques needed for the Markowitz calculation, which will permit it to solve optimally for several hundred securities simultaneously.

[53] K. Arrow and L. Hurwicz, *Decentralization and Computation In Resource Allocation,* Technical Report #56, Department of Economics, Stanford University Press, Palo Alto, Calif., June, 1958.

[54] H. Uzawa, "The Stability of Competitive Economy," Abstract reported in *Econometrica,* April, 1959, pp. 304-305.

[55] S. Reiter, *A Market Adjustment Mechanism,* School of Industrial Management, Purdue University Press, Lafayette, Ind., 1959.

equilibrium state of each member of the aggregate.[56] This is quite important since none of the taxpaying units in our simulation model will ever equilibrate once and for all; yet the market mechanism should be based on a mechanism that is, at least, constantly seeking equilibrium. Since the market models are perhaps less important in the over-all scheme of the simulation model under discussion, it would probably be sufficient to build it as a process of successive approximations. The market model continually accepts knowledge of the volume of each security demanded and offered in each time period and computes an "excess demand price" [57] (positive or negative) which is the difference between the demand price for a given volume and the supply price for a given volume. From this point, the period-to-period change in market price and market volume will be in the direction indicated by the positive or negative nature of the present and preceding periods' excess demand price. While the specific model to perform this function does not yet exist, it should not be a difficult one to construct.[58]

### *Input Sources*

Micro-simulation imposes stringent, but not new, data requirements. Information about the reactions of individuals to different policies and environments to determine the "actual pervasiveness of tax effects can be established only by empirical inquiring." [59] But, except for isolated cases where sample survey methods have already been used in conjunction with household interviews, the major hope lies in the sharp increase in our knowledge of survey research techniques and other methods of collecting and ascertaining data about micro-units. For example, the incomes of households in a specific year, derived from Survey of Consumer Finance data, were used to derive year-to-year lifetime income patterns for households of various types.[60] To the extent that the reaction of different types of tax units are determined from *manned* simulations—i.e., humans in a simulated environment (see above, p. 296)—the need for data about micro-units becomes less "important," although some will always be needed for validity-checking on the realism of the simulation participants' performance. Regardless, the type of data needed for a simulation effort like this is *not* the ordinary aggregative data which, when processed, lose identification of the behavior of the individual units making up the aggregative. Rather, they are data about the income patterns, growth and income goals, liquidity positions, and security holdings of a selected cross-section of tax-affected household units. Even without these data, however, the simulation can prove extremely useful: the discipline of having to spell out the separate models, particularly to a rather unimaginative computer, imposes the need for a clear statement of

56 P. K. Newman and J. Wolfe, *An Essay on the Theory of Value*, School of Industrial Management, Purdue University Press, Lafayette, Ind., May, 1960.

57 *Ibid.*, p. 27.

58 Individuals at The RAND Corporation are in the process of developing this mechanism for another simulation model. A recent report of modelling activity being pursued in the School of Industrial Management at Purdue refers to a market model similar to that proposed here. See V. L. Smith, "Investment Planning over Time," *Proceedings of the Pilot Clinic on the Impact of Feedback Control Concepts*, FIER, New York, October, 1960, pp. 47-50.

59 Butters *et al.*, *op. cit.*, p. 167.

60 R. Summers, "The Income-Dynamics of Households," Abstract, *Econometrica*, April, 1959, p. 277; see also Steger, *op. cit.*

certain needs as inputs; also, since a simulation effort such as this often proceeds through several phases and addresses itself to many questions, there may be an economy in that data collected for one operation become applicable to others; and, finally, to the extent that the data about tax units are produced *by* the experiment (rather than *collected for* it) in these areas where empirical data are difficult to collect, simulation may aid considerably in the generation of useful data about taxpayers' decision-making and action-taking.[61]

These are by no means all the features of such a simulation requiring detailed examination prior to, and during, the exercising and analyzing of the models. Experimental design considerations, for example, are highly relevant, as are questions of proper computer programming, the adequacy of the representation of reality, etc. But these questions have their current " state of the art " answers and are too technical, perhaps, for the interests of the general reader.

## CONCLUSIONS

Two questions are now ready to be asked. First, since this model is only a proposal, is it feasible and " will it work? " Second, how specifically would it help resolve the five classes of differences among tax experts discussed on p. 287 above?

Developmental abstract simulations have dealt with problems equally complex as those of Federal tax proposal evaluations. They have succeeded both in greatly enhancing understanding and in producing specific recommendations for system improvements.[62] And less developmental, more aggregative simulation models have already been used to study specific tax proposals: in their simulation study of the U.S. economy in recession, Duesenberry *et al.* evaluated the effectiveness of automatic income tax rate changes upon the stability of national income; [63] and the author has investigated certain effects of the carry-over of unused exemptions through a simple recursive simulation model which postulated several different groups in the labor force who would be affected differentially, during different stages of the business cycle, by the tax proposal then under consideration.[64] The model under discussion in this paper, while more ambitious than either of these (from the standpoint of tax policy evaluation) is certainly feasible.

As to its potential utility, I believe such an exercise would help relieve tax experts from certain of their present difficulties:

(1) In any single analysis, it would permit them to encompass as wide a scope as they deem necessary to solve their problems. They would not have to make as many limiting assumptions " for the sake of simplicity " where simplicity is damaging to a proper analysis.

(2) It would permit them to examine the operation of individual tax units more deeply. While for many branches of economic theory, it may be sufficient to develop highly abstract economic models to explain the behavior of certain

[61] We have restricted ourselves in discussing inputs to the question of the data needed about the micro-units. No special problem exists with respect to the aggregative data, such as that of " economic conditions," needed for all the decision-makers together.

[62] R. Rauner, *Laboratory Evaluation of Supply and Procurement Policies*, The RAND Corporation, Report R-323 (ASTIA No. AD 156042), July, 1958; Haythorn, *op. cit.*; Chapman, *et al.* " The System Research Laboratory's Air Defense Experiments," *Management Science*, April, 1959, pp. 250-269.

[63] Duesenberry, *op. cit.*, pp. 766-768.

[64] Steger, *op. cit.*, pp. 619-620.

economic parameters, it is *not* enough where detailed aspects of policy selectively affect different proportions of the taxpaying population. For example, it is simple to demonstrate how difficult it is to predict how an aggregate will perform, without knowing how the aggregate's component units behave.

(3) Humans are the vital but inscrutable elements responsible for tax actions. We have dangerously little knowledge of their likely behavior—both " rational " and otherwise—in the face of different conditions. The developmental micro-simulation focuses its attention on this problem.

(4) By using aggregative data, we can make so many different interpretations about the effects of tax-policy alternatives that it will do no *harm*, certainly, to refocus our data collection needs from the aggregative impacts of taxes to the micro-level. Furthermore, at this level, more scientific sampling techniques—perhaps using the U.S. Treasury Department's extensive data files by individual tax-paying units—can help avoid disagreements over " the meaning of the data."

(5) Simulation can shed light on dynamic relationships, such as suppliers becoming demanders over time and vice versa, in a way that no other technique has yet been able to duplicate. Thus, the specific meanings of these dynamic relationships can be made clearly observable to all concerned, and the effects of any changes in assumptions about them can be quickly detected.

(6) While simulation cannot always help resolve differences among experts based on disagreements as to over-all system goals, it does (as in the data-gathering phase) strictly discipline the user to spell out carefully the goals and sub-goals of the system under study. Sometimes, the sheer delineation of goals helps to clarify and then resolve the difficulty.

In sum, this paper describes a proposed simulation model for studying certain important aspects of tax policy. Its primary object is to acquaint public finance experts with the potential rewards which new management-science and econometric tools can yield in the analysis of alternative tax proposals. There is good reason to believe that the model described here is feasible, would be relatively inexpensive, and would furnish a systematic and rational approach to a problem area which has been fraught with incertitude and controversy.

# NTA NOTES

## *From the President*

The first thing I would like to do on my assumption of the presidency of the National Tax Association is to congratulate my predecessor Paul E. Alyea on the very constructive administration he has conducted since he was elected to head our organization last September in New York. He has given careful thought and effective effort throughout the year. The appointments of Leslie E. Carbert and Ronald B. Welch, both of California, as Co-Chairmen of the Program Committee and William S. Schumacher and Edward J. Notske as Honorary Chairman and Executive Chairman, respectively, of the Local Arrangements Committee assured the Seattle Conference one of the best in technical programs and entertainment features. The early appointment of these Conference officials gave them the necessary time for the preparation and execution of their important duties.

I am glad to have the support of the following newly elected officers: C. Emory Glander, Vice President and Donald C. Miller, Treasurer. Our efficient Secretary, Leo Mattersdorf, was reelected. We are thus assured of the continued advantage of his advice and experience. The new Executive Committee members are:

| | |
|---|---|
| Roger A. Freeman | — California |
| Leonard E. Kust | — Pennsylvania |
| Clarence W. Lock | — Michigan |
| C. J. Riley | — Illinois |
| Donald O. Wright | — Minnesota |

The outgoing members have loyally served the Association. We regret seeing them leave the Committee, but know all will continue their activity in N.T.A. and their attendance at the Annual Conferences.

The Nominating Committee selected at the Seattle Conference to determine the officers and five new Executive Committee members for presentation to the members for voting at the Miami Beach Conference were:

| | | |
|---|---|---|
| Carl S. Shoup | — New York | *Chairman* |
| H. Kenneth Allen | — Illinois | |
| J. Keith Butters | — Massachusetts | |
| Leslie E. Carbert | — California | |
| Albert W. Ward | — Maryland | |

Any member having suggestions to present to the Nominating Committee should write same to one or more of the committee.

With respect to the Miami Conference particularly, and, as to any other matters as well, you are urged to make any suggestions that occur to you. Your suggestions or wishes will be most welcome and helpful.

OTIS W. LIVINGSTON
*President*

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### *From the Executive Director*

President Livingston prepared his NOTES for the September JOURNAL at the conclusion of the Seattle Conference.

*Seattle Conference*

In the many years of attendance at N.T.A. Conferences, as a member and recently as Executive Director of the Association, I cannot recall a single one which had all the elements of a successful meeting so well blended and synchronized.

As President Livingston mentioned, the Committees (Program and Local Arrangements) worked early, continuously and hard to come up with the splendid results.

Les Carbert and Ron Welch did an outstanding job of getting the speakers to supply prepared speeches. Bill Schumacher and Ed Notske performed excellently in all the entertainment preparations. Ed Notske laid down a plan which future chairmen of Local Arrangements Committees could well follow. Details such as decorations of the registration area and the registration list with a *totem pole* motif made it interesting and attractive to all visitors.

Mrs. Schumacher and Mrs. Notske headed a fine Ladies Committee. Mrs. Notske's sister carried out the unusual artistic work. The cruise to KIANA LODGE for a salmon barbecue was delightful. Our return trip through the government locks followed the view of the beautiful illumination of the Seattle shoreline. We had clear weather and mild climate—not one rainy day! Mt. Rainier, at sunset, could easily be seen from our hotel room windows.

A tribute to the excellent publicity is in order as there never has been a finer coverage at any conference.

*Seattle Conference Attendants*

Martin Saxe was the only honorary member of the Association who attended the Conference. It was his forty-fifth (45th) consecutive conference. He received a standing ovation when introduced at the banquet.

The long distance attendants were Hiroshi Ibaragi of a government agency in Japan, and Mr. Ram Singh, of the India Administrative Service, who joined the Association.

*Future Conferences*

**1962 – Miami Beach, Florida**
**1963 – Milwaukee, Wisconsin**
**1964 – Pittsburgh, Pennsylvania**
**1965 – New Orleans, Louisiana**

*Membership*

The new Membership Committee will be headed by Vice President C. Emory Glander of Columbus, Ohio, a long time active member.

Some new members were gained at Seattle.

All of those interested in attending our future annual conferences and receiving the Proceedings of the Seattle Conference are invited to join N.T.A.

**PLEASE USE THE ATTACHED CARD**

**EITHER FOR MAKING A RECOMMENDATION**

**OR**

**HAVING A PROSPECT SIGN AN APPLICATION.**

Walter J. Kress
*Executive Director*

## APPLICATION FOR MEMBERSHIP

Walter J. Kress, Executive Director
National Tax Association
905 Payne-Shoemaker Building, Harrisburg, Pennsylvania

Date..................

I agree with the objectives of the National Tax Association and authorize you to enroll me as a member. As such, I will receive the quarterly NATIONAL TAX JOURNAL and the PROCEEDINGS OF THE ANNUAL CONFERENCE. I desire my membership made effective with the quarter beginning:

July, 19.... ☐
Oct., 19.... ☐
Jan., 19.... ☐
April, 19.... ☐

and enclose my check made payable to National Tax Association for $........ in payment of dues as

☐ A student in a recognized institution of higher learning ................$ 10.00
☐ An employee of a government or of a school, receiving more than half of my income from such employment ..$ 10.00
☐ An individual not coming within the preceding categories ..............$ 25.00
☐ A corporation ......................$ 100.00
☐ One who wishes to contribute more liberally to the work of the Association .................... Up to $1,000.00

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Address ........................................................................................................
(STREET) (CITY) (STATE)

Name .................................................... Date ..........................
(INFORMATION SUBMITTED BY)

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# NATIONAL TAX ASSOCIATION

**Organized 1907—Incorporated 1930**

**OBJECT.** The National Tax Association is a non-political, non-sectarian, and non-profit-making educational organization. Its object, as stated in its certificate of incorporation, is to educate and benefit its members and others by promoting the scientific study of taxation and public finance; by encouraging research; by collecting, preserving, and diffusing scientific information; by organizing conferences; by appointing committees for the investigation of special problems; by formulating and announcing, through the deliberately expressed opinion of its conferences, the best informed thought and ripest administrative experience available; and by promoting better understanding of the common interests of national, state, and local governments in the United States and elsewhere, in matters of taxation and public finance and interstate and international comity in taxation.

**MEMBERSHIPS.** The Association welcomes to its membership, for mutual discussion and deliberation, all who may be interested in taxation and public finance generally. Annual dues are: memberships for students in recognized institutions of higher learning, $10; memberships for government agencies, schools, and persons receiving more than one-half of their income from employment by such agencies or schools, $10; memberships for other individuals and unincorporated entities, $25; corporate memberships, $100; persons wishing to contribute more liberally to the support of the Association, $100 to $1000.

**PUBLICATIONS.** The NATIONAL TAX JOURNAL is published quarterly in March, June, September, and December. PROCEEDINGS of the annual conferences on taxation which are sponsored by the Association are published soon after the meetings. The JOURNAL and the PROCEEDINGS are sent to members without charge. To non-members the price of the JOURNAL is $5.00 per year, single numbers, $1.50. The prices of the PROCEEDINGS vary; that of the 1960 volume is $15.00.

Applications for membership, orders for publications, and general inquiries should be addressed to Walter J. Kress, Executive Director, National Tax Association, 905 Payne-Shoemaker Building, Harrisburg, Pennsylvania.